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The literature of tropical agriculture during the last ten years has dealt so largely with rubber that the onlooker might be excused for judging that the Agricultural Departments of Tropical countries had no thought for any other product. Yet the period in question will ultimately be noted, in agricultural history, for the initiation of another movement,—fraught with much greater consequences for the native cultivator and the indigenous population,—which does not lend itself to booms and has practically escaped notice. We refer to the investigations and experiments which are being conducted in almost every tropical country with a view to the improvement of rice cultivation.

In Japan and Italy, two of the chief rice growing countries of the subtemperate zone, much has already been done in this direction. Developments in the Tropics are more recent, but Java has been in the field for some time, India has followed suit, British Guiana has made considerable progress, while Indo-China is the latest recruit and, as the article quoted elsewhere proves, is profiting by the experience of the pioneers.

In many respects, the situation must appear extraordinary to the expert agriculturist of temperate countries. The improvement of cereals is now a fine art. Its rules and methods are well established, and have been practised on almost all such crops with results which are too well known to need mention. Yet in the case of rice we have a plant to which though it provides the staple food of millions of people, even the simplest methods of amelioration have not been applied except in very limited areas.

The keynote of modern methods of improvement of cereals is selection. Mass selection is already practised in the case of rice in some countries. In Japan, the upper third of the head is gathered for seed, because the grains at the top are the heavier.

And elsewhere the heaviest grains are selected by placing the seed in water, or in solutions of greater density. But these mass methods do not lead to permanent improvement, as the seed so selected is always a mixture and deteriorates by crossing.

The earliest efforts in the selection of wheat, oats, etc., were made by individual farmers, more or less as a hobby. Single ears of marked quality were selected, and from these plants were raised, until sufficient seed had been obtained. This phase appears, on the available evidence, to be lacking in the case of rice. In recent times, selection and improvement by crossing has become the special work of professional seed growers, with the consequent production of strains which are household names among agriculturists.

A great impetus has been given in recent years by the introduction of the method of pure line breeding, thanks to the investigations and discoveries of the Experimental Station at Svalof in Sweden. In this method, pedigree races are raised, beginning with a single grain. Deterioration by crossing is thus avoided, as all the plants have the same origin. The method is not a new one in itself, as it was practised in Scotland nearly a hundred years ago by the originator of the famous Sheriff oats, but in its modern developments it is the creation of the Svalof station.

It may be urged that this method is too slow for adoption in practice. The reply to that objection is that it is the only method which gives permanent results, and it is sufficiently rapid to be adopted by commercial enterprises. The station at Svalof, though it receives grants from the State, is a private institution, and a similar station has been established in France by a private association.

Experiment stations for rice in the Tropics are following the Svalof methods with promising results. In Java, a variety which yields $2\frac{1}{2}$ tons of rice per acre has already been raised at the experiment station at Buitenzorg. That Ceylon rices will lend themselves to improvement by this method is evident from the fact that the best variety now under cultivation in British Guiana was obtained by selection from a Ceylon consignment.

It is now generally agreed that mass selection, though temporarily of benefit, cannot effect any permanent improvement, and that new varieties introduced from abroad and distributed to the native cultivator must, in general, deteriorate by crossing with the local mixed races. The hope of permanent improvement and increased production lies in the adoption of pure line breeding, and the regular distribution of pedigree seed.

T. P.

RUBBER.

A NEW RUBBER SMOKING MACHINE.

BY H. W. FARWELL, A.B., & M. H. KORN, C.E.

[As the improvement of the quality of plantation rubber is the question of the day with all who are interested in the industry, we need tender no apology for reproducing from THE INDIA RUBBER WORLD the following description of yet another rubber coagulating machine based on Brazilian methods. Our readers will, no doubt, understand that the first part of this article is of the nature of advertisement and will take its statements accordingly, but we have to confess to a feeling of surprise that the patentees of rubber machines should in general think it incumbent on them to enlarge on the inefficiency of their prospective clients.

We have not the least doubt that if MESSRS. FARWELL AND KORN would send out one of their machines they would find rubber estate companies willing and eager to give it a thorough trial under estate conditions, *as they have done in other cases.*

If we may offer them advice, we would urge them not to handicap their invention by demanding royalties on rubber manufactured by it—a course which is about as reasonable as would be the action of a patent mangle company which required a royalty from all the washerwomen using it.

One point further. Either the advocates and users of these machines have to persuade the brokers and rubber buyers to take rubber which is exuding a tarry liquid, or the planter must store his rubber for at least three months before it is ready for shipment. The latter course may probably be ultimately necessary, but at present inventors persist in ignoring the length of time required to make an Amazon ball, and to put it on the market. The adoption of the usual type of rubber coagulating machine (i.e., in which coagulation is effected by smoke) by an estate, would, as the market is constituted at present, involve the loss, or rather permanent postponement, of three months' income, unless the new machine was brought into operation gradually.

Comments on MESSRS. FARWELL AND KORN'S article are enclosed in brackets.—ED. T. A.]

When in the summer of 1910 MR. E. A. KORN, the crude rubber importer and merchant of New York, made his tour of the rubber producing countries of the Far East he was greatly impressed by the uneconomic and inefficient methods employed on the plantation in the production of crude rubber from rubber latex.

Having visited Brazil several times before taking his trip East he was naturally well acquainted with the careful coagulating and curing methods in use there, so the difference between the two methods of coagulation was brought home to him most forcefully, and it was easy for him to explain the

evident reasons for the difference in quality of the resulting rubber. It is, of course, well known that the market value of best plantation fine is about 10 cents per pound lower than that of Brazilian Upriver Fine, but that this self-depreciation is entirely unnecessary and can be avoided is not so generally known to the plantation owners.

MR. KORN, in an interview with the CEYLON OBSERVER, stated at the time of his stay in Ceylon that if plantation latex were smoke-coagulated and cured like Brazilian, the resulting rubber would be equal in quality and market value to Brazilian Fine from the Tapajoz region. His views were seriously disputed by a few whose actual experience and knowledge of the subject really did not entitle them to assume the rôle of critics. It is quite clear to those who are capable of logical reasoning that if certain treatment is applied to a certain organic substance with a certain resulting reaction, the same treatment applied to the same organic substance, in another part of the world, will cause the same reaction—and a like product will result in both cases. [This presupposes that the details of the method are exactly known and can be carefully controlled. The same "argument" may be applied to milk. If a given quantity of cow's milk is placed in a certain kind of churn which is rotated for a fixed number of times, the butter produced will always be the same !—ED.] This argument covers the case exactly and completely, for the two latices come from the same species of trees—*Hevea brasiliensis*. There are, of course, some differences in soil and climatic conditions as well as in the age of the trees, but they do not seem to have any appreciable effect either way on the quality of the latex tapped in the East.

It must therefore be admitted that the rubber producers of the East are at the present time incurring a large loss in possible returns, a loss which in fact amounts to approximately $20,000,000 annually, because the inferior and inefficient methods of coagulation decrease the value of the resulting rubber to that extent.

It is the purpose of this article first to show the truth of the existence of this actual loss of $20,000,000 per year to the planters ; secondly, to show how this immense loss may be practically eliminated by the use of proper coagulation and curing methods, and, thirdly, how these methods can be effectively employed on the rubber plantations of the East.

We shall assume in our computations that the quality of Eastern rubber cannot quite be brought up to the finest Brazilian Upriver Fine—even by proper coagulation. This assumption is made simply to be on the conservative side of our estimate. It is to be expected, of course, that the latices are a little different in chemical composition, first because the soils are somewhat different, the soil in Brazil being alluvial while that in the East is mostly primary formation (laterite). Secondly, most of the trees in the East are younger than those tapped in Brazil, and the latex from young trees contains slightly more resin, which tends to weaken rubber. [The theory that the difference in resin content of plantation rubber accounts for the difference in quality has been repeatedly shown to be untenable.—ED.] It must further be remembered that the Eastern trees are all seeded from the *Hevea* of the Tapajoz region in Brazil.

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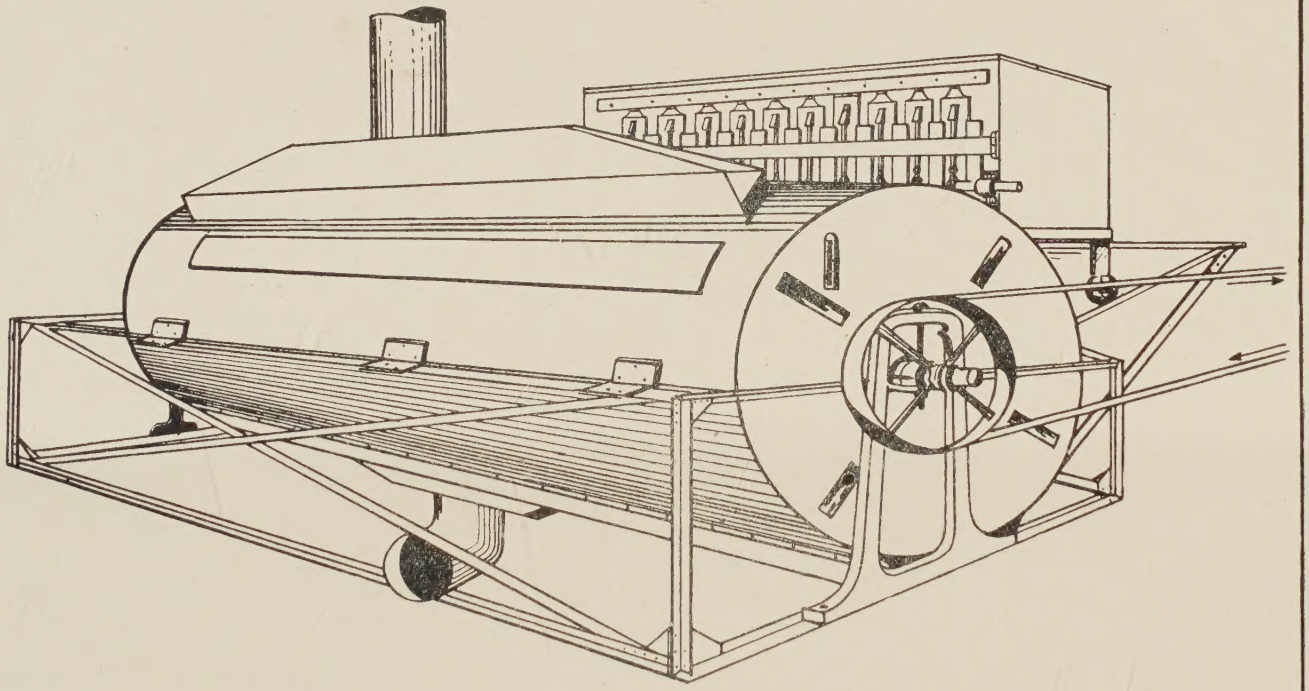
From The India Rubber World.



GENERAL VIEW OF RUBBER COAGULATING MACHINE.

General dimensions:
6′ 0″ x 4′ 0″ x 5′ 0″.
Patented in the plantation rubber producing countries.

Designed by Max Henry Korn, C.E.,
82 Beaver St., New York.
Hermon W. Farwell, A.B.,
Dept. Physics, Columbia University.

We shall therefore draw our comparison between Tapajoz Fine rubber and plantation smoked sheet, based upon market conditions existing in New York at the beginning of March, 1914 :—

Market price of Tapajoz Fine per lb.	72 cents
Market price of plantation rubber smoked sheet, per lb....	61 „
Actual loss in returns to planters, per lb. ...	11 „
Loss in weight in washing Tapajoz Fine	20 per cent
Loss in weight in washing plantation smoked sheet ...	3 „
Value of Tapajoz Fine to the manufacturer after washing, per lb.	86 cents
Value of plantation smoked sheet to the manufacturer after washing, per lb.	63 „
Excess value of Tapajoz over plantation ready for working, per lb.	23 „

This at the present rate of production of about 50,000 tons per year means an approximate loss of :—

$\frac{50{,}000 \times 2{,}000 \times 20 \text{ cents}}{100}$ (taken conservatively) = $20,000,000 to the plantations taking part in this enormous production.

Having proven the rather startling fact that this article of immense commercial utility is being produced to the extent of 50,000 tons per year at an actual monetary deficiency in legitimate and possible returns of approximately 20 cents per pound, we shall now show :—

(1) That the inferior quality of Ceylon rubber is due to improper coagulation methods.

(2) That the Brazilian process of coagulation, if applied to Eastern latex, will produce rubber in every essential of quality like Brazilian Fine Rubber, and will add $20,000,000 to the annual returns of the plantations in the East.

(3) That the Brazilian process of coagulation can be applied to Eastern conditions of production if it is made mechanical.

Regarding our first contention, namely, that the inferior quality of Eastern rubber is caused by improper coagulation methods : It is generally known that the methods employed on the Eastern plantations at the present time merely result in a more or less complete coagulation (without curing) of the latex, i.e., they simply draw together the rubber particles in the latex, with their consequent more or less complete separation from the water content, which often runs as high as 65 to 70 per cent. None of the processes effect the counteractions of the proteins which later cause putrefaction of the rubber and a conversion (within a comparatively short time) of the good rubber into a sticky, lifeless substance. It is equally well known, at least among manufacturers of rubber goods, that any rubber coagulated in this way lacks in resiliency ; it is " short," and does not possess the long life of good Brazilian rubber. [We do not understand what is meant by " counteraction of the proteins," and, in general, plantation rubber does not putrefy. —ED.]

It is for these reasons that plantation rubber, although produced from the same species of trees as Brazilian, has been lower in actual value than Brazilian grades.

If in contrast to the above we will now study the Brazilian methods of coagulation, we cannot help but feel that it will result in a far superior grade of rubber. The latex there is coagulated and cured in layers no thicker than 0·01 of an inch (0·25 of a millimetre) by the chemical and preservative action of the smoke of tropical woods. This smoke is composed of a complexity of gases, including hydrocarbons, carbon monoxide and dioxide, and, most important from our standpoint, slight quantities of acid and creosote vapours. The acid vapours bring about coagulation, but being in such dilute condition they cannot injure the rubber fibre. [It has been proved that the amount of acid in Hard Para is greater than that in Plantation Hevea.—ED.] Creosote is known to be one of the most powerful preservative agents. Its action on the latex is to eliminate the protein matter which in time would cause the putrefaction of rubber which is known as tackiness. [This is quite a new claim. Hard Para is supposed by many to retain all the proteids. We do not understand how the proteids can be "eliminated" by creosote, and it has not yet been demonstrated that putrefaction of the proteid has anything to do with tackiness.—ED.] Finally, the heat of the smoke brings about the evaporation and consequent removal *during* coagulation of a large percentage of the water in the latex. This, it is presumed, will allow a more perfect union of the molecular particles of rubber and a consequent greater intermolecular attraction (cohesion) than if all the water remained until *after* coagulation. This ought naturally to result in a *greater tensile strength*. [Here, again, the inventors are in conflict with their confreres, who claim that the coagulated rubber contains all the constituents of the latex, even the water! For the rest, these five lines contain a number of scientific terms, but the attempt to extract any meaning from them will certainly tax the tensile strength of the reader's brain.—ED.]

Our second contention, namely, that the standard of quality of plantation rubber can be raised to that of Brazilian Tapajoz Fine, can be proven by a series of experiments like those conducted by the designers of the smoke-coagulating machine described below. Furthermore, the latices are drawn from trees of the same species, as already mentioned; therefore they ought to be, and have been proven to be, very similar in chemical composition, and to yield to the same treatment with similar results. The loss of $ 20,000,000 per year is therefore an unqualified waste, and can be avoided, as it is simply the result of uneconomic production methods.

Regarding our third contention, namely, that the Brazilian process of coagulation can be applied to Eastern plantation conditions. We have performed many quantitative experiments which have proven beyond any doubt that the Brazilian coagulation operation can be performed by a machine.

The slowness and laboriousness of the Brazilian hand process is therefore no more a deterring factor to its use on plantations.

The coagulating machine, which M. H. KORN, civil engineer, and H. W. FARWELL, lecturer and instructor in the department of physics at Columbia University, have evolved and patented after three years of study and experimentation, performs the coagulation operation exactly as the Brazilian does it, but with a very great saving in labour and time. The several machine models have shown under exact quantitative experiments that we can coagulate and cure up to 1½ tons of latex per day of 10 hours on one machine, the resulting rubber being exactly like the Brazilian grade of smoke cured rubber.

The efficiency of the machine and its large capacity are simply the result of:—

(1) A larger coagulating area on which the latex may be exposed to the coagulating and curing action of the smoke.

(2) A more undiluted and thorough application of the smoke constituents.

(3) A more rapid, exact and even application to the coagulating cylinder of the minutely thin layers of latex, none of them being thicker than 0·008 of an inch (0·2 of one millimeter).

(4) The timely use of a correct and evenly preserved smoke-temperature.

GENERAL STRUCTURE OF THE COAGULATING MACHINE AND ITS MODE OF OPERATION.

In order to obtain a general conception of the structure of the machine reference will be made to the perspective drawing in the following description:—

The machine consists essentially of a smoke chamber, within which a coagulating cylinder revolves at a constant speed, and which is carried by lugs on the truss frame. A smoke inlet and an exhaust port are so disposed over the surface of the smoke chamber that the coagulating smoke, which is kept at a constant temperature throughout, will completely envelope the coagulating cylinder at all times. The latex is conveyed from the general receiving tank to the latex reservoir seen in the drawing on top and a little to one side of the smoke chamber. The reservoir runs on a track, bolted to the rear of the truss frame, so that it may be moved toward or away from the coagulating cylinder as required. The front face of the reservoir is fitted with a series of orifices, which are opened and closed by means of gates. These gates are actuated by a central cam shaft and a series of cams. The cam shaft is operated by a set of intermittent or "time" gears, which in turn obtains its power from the main shaft of the coagulating cylinder. This time gearing, not seen in the illustration, is a necessary and ingenious adjunct to the machine, inasmuch as it provides for and automatically takes care of the most disturbing factor in smoke coagulation, namely, the variation in the percentage of water contents in the latex. The rapidity of smoke coagulation depends almost entirely on this. The time gearing gives a range of from one-quarter to five times the average length of time required to completely coagulate a layer of rubber of constant and predetermined thickness. The sectional area of the latex orifices may be varied somewhat, but is ordinarily set so that the flow from them is such as to deposit a layer of latex of 0·008 of one inch maximum thickness. The smoke generator is a simple grated combustion chamber so arranged that slow combustion of the fuel will take place in order to generate the maximum amount of smoke. The gases of combustion are drawn into the machine by suction, there set in whirling motion to reach every exposed particle on the surface of each new layer of latex, and are then expelled into the atmosphere. The orifices are protected against any possible clogging by precautionary devices, which have shown their effectiveness in actual tests on models of the machine.

The operation of the machine is somewhat as follows: The batch of milk to be coagulated during the day, and stored in a general receiving tank is first tested for its water contents by means of a small gage. The percentage of water present being known, the intermittent gearing which fixes

the time allowed each new layer of latex to coagulate and cure is set by the movement of a setting lever to the correct time gear. The latex is then allowed to run into the reservoir, which it will fill to a certain depth, kept constant throughout the operation. The smoke generator, having been started, it is made to pass into and through the machine. Before entering, however, the gases are brought to the correct temperature for proper curing, considering the water contents of the latex and several other factors. The coagulating cylinder may now be started revolving, and the time gearing operating the orifice gates set in motion. Successive thin layers of latex will then be deposited upon the surface of the coagulating cylinder, and cured successively until the operation is stopped at night. The smoke chamber doors are then opened, and the whole thickness (possibly up to a foot thick) of the coagulated rubber is removed from the cylinder. The machine is then ready for the following day's work, except for certain mechanical cleaning and oiling.

The economic importance and value of the machine can be easily appreciated by the plantation owners, but it will be interesting to enumerate some of the beneficial results of its installation and use:

(1) It will eliminate the enormous loss incurred through present uneconomic coagulation processes.

(2) It will materially reduce the operating expenses on plantations, for the machine with only one attendant will convert the fresh latex into smoked rubber.

(3) It would put plantation rubber on a sounder basis in its competition with "wild rubber," and thereby increase the value of plantation rubber investments to a material extent.

Throughout the work of mechanical development and final design of the present embodiment of the machine, the designers kept the fact in mind that in order to avoid committing serious errors of design it would be necessary to construct a machine which in principle would perform the Brazilian method of coagulation and curing exactly as the Brazilian does it. In the development of the present machine the designers were greatly assisted by their friends in Brazil and the East whose reliable information regarding the Brazilian process and other important conditions of production was found to be necessary to the successful completion of the designs of the machine. The designers were especially careful to verify all the important phases of the process by personal experiments conducted in the laboratories with a quantity of fresh latex sent for that purpose from the Ceylon plantations. All these experiments were performed quantitatively, the results being noted very carefully on experimental log-sheets for future reference.

The construction and operation of the machine are both extremely simple, for the designers realized that next to embodying the principle of the Brazilian smoking process the machine must be very simple to operate, and mechanically suited to the conditions existing on plantations. The capacity of the largest practicable machine is about $1\frac{1}{2}$ tons of latex per day of 10 hours' continuous operation. Smaller machines with less output, but capable of equally efficient results, can, however, be built to suit the individual demands of the various plantations.

THE RUBBER INDUSTRY IN GERMAN EAST AFRICA.

H. M. Consul at Dar-es-Salaam (Mr. N. King) reports that the low prices prevailing in 1913 had a disastrous effect on the *Manihot* rubber plantations in German East Africa. The set-back in the economic development of the Colony is a serious one, as rubber cultivation is one of its most important interests, there being probably 19,000,000 trees planted in the Colony, of which about half are ready for tapping. Owing to the low prices all the plantations limited the number of hands employed, and two of the largest suspended tapping entirely.

Planters have made urgent appeals to the Government for assistance, and some relief has been afforded. Unless, however, the price of rubber improves greatly it is difficult to believe that any official measures will enable the planters to reduce their costs of production sufficiently to make the rubber-growing industry profitable. Railway freights have been reduced and the sea freight has been lowered from 90 marks to 50 marks (from about £4 4*s*. to £2 9*s*.) per ton, while the payment of Customs export fees has been deferred. Acids for the coagulation of rubber are imported free of duty, and the Colonial Economic Committee is endeavouring to obtain a reduced freight for materials used in collecting rubber.

The request of the planters for a further extension of the period of contract for labourers has not yet been granted, and can hardly be expected in view of the fact that the Government has already extended to 240 working days the time for which contracts may be made. This new regulation came into force on 1st October, 1913, and its effects have not yet been felt very much on the plantations.

The planters are heavily handicapped by having to pay the costs of recruiting labour in the interior and its transport down to the plantation. These costs often amount to about £2 10*s*. per head before work is begun, and the rate of wages is high—about 16*s*. 6*d*. per month for a Wanyamwezi tapper.

Owing to a slight rise in the price of rubber, tapping has been resumed by some of the planters and a more hopeful feeling is abroad. The smaller planter has probably a better chance than the large Company; his working expenses are less, he can often obtain local labour cheaply or get time-expired hands without paying recruiting fees and in addition he can keep his men under more personal control. The outlook for the larger estates is far from reassuring, and it is said that some of them have already begun to cut down the rubber trees to make room for other crops.

The Colonial Economic Committee is taking steps to introduce a standard quality of East African rubber, the absence of which is another difficulty which has hampered the planters. There is only one large washing and curing factory in operation in the Colony, at Muhesa, though there are several smaller ones in Usambara. Most of the planters wash the rubber themselves, with the result that it has often to be done again in Europe.—London Commercial Record.

HEVEA SEED SELECTION.

(Dr. P. Arens, of the Rubber Experiment Station, Malang, makes the following remarks on the question of seed selection in Hevea in his account of his recent visit to Ceylon and Malaya).

In view of the fact that when rubber plantations were established in Java no selection of seed was practised, all the seed being planted out as soon as it was received, it was important to ascertain what had been done in other countries in this respect. It was at once evident that in the districts which I visited nothing of the kind had been attempted. The demand for seed was so great during the rubber boom that no one could consider proper seed selection.

Now that the demand has ceased and the majority of the plantations produce all the seed they require, one would expect that more attention would be given to this question, more especially as examples in other products demonstrate how important a good selection of seed can prove and how the future may depend entirely upon it. One need only call to mind the case of cinchona which in Java alone, in contrast to the universal experience of other lands, can be profitably cultivated, chiefly because in that country the value of an improvement in the alkaloid content was early realised. In Ceylon Cinchona has almost entirely disappeared. It strikes one therefore as all the more surprising that the melancholy experience gained with Cinchona has not taught the English planter to be more on his guard in this matter.

While here in Java a great number of plantations may already be found where the seed of selected specially good trees on the plantation itself has been planted out for extensions or supplies, very little has, in general, been done in this matter in the English Colonies. Of the different countries visited there was only one in which the importance of this question had been grasped and fields had been established with seed of one kind, obtained from specially good yielding trees. Information afforded by the various Departments of Agriculture shows that this is really an exception.

The Department of Agriculture in Ceylon has recently taken more interest in this question [since 1911, to be exact.—Ed.]. A field is to be seen on the Experiment Station at Peradeniya which is planted with seed from the well-known tree at Henaratgoda which has attracted so much attention owing to its yield of 275 lb. in 3½ years when 35 years old [386 lb. in 4½ years.—Ed.]. The plants are as yet too young to say anything about. In addition, a number of selection experiments have been instituted which are provisionally only of purely scientific importance and which may serve to elucidate how far individual characteristics in Hevea, such as large or small leaves, light or dark coloured seeds, etc., are hereditary. It is possible, however, that these experiments may have a practical value also, since it appears that certain external characteristics may be associated with other desirable qualities.

In this connection, most remarkable ideas are current in English Colonies. There are planters who assert that a certain coloured bark only occurs on good yielding trees, etc. But all these practical observations prove groundless on further investigation. One planter, for instance,

declared that trees with a rose-coloured bark were especially valuable, while on another plantation exactly the same trees were described as worthless. Such opinions do no harm, so long as they are not made the basis of a system of selection. In the present instance the planter in question was so certain of the truth of his observation that he intended to use the seed of such trees for the improvement of his plantation, without first tapping them because he preferred seed from untapped trees. It is unnecessary to enlarge here upon the dangers of such a method. Naturally, only the productive capacity of the tree can afford a rational basis for selection, and that must be determined empirically by tapping.

There are however certain characters which, at least as regards Ceylon, afford a conclusion as to the value of the tree. There exist, for instance, two types of bark in Hevea. The one remains smooth at all ages, while the other becomes rough and its outer layer grooved. Trees with the first kind of bark are generally poor yielders. Microscopic examination shows that in such bark the latex tubes occur only close to the cambium, for which reason the yield is smaller. [This is true only of one type of smooth bark.—Ed.] Bark of this kind is also generally thinner than normal bark. Trees with a yellow inner bark are also poor yielders. The renewed bark is the same in all trees, so that the trees just mentioned are poor, only during the tapping on the original bark.

Planters are not yet agreed whether seed should be taken from tapped or untapped trees. A great number of the estates in Ceylon were planted with seed from the Henaratgoda trees which were then practically untapped. Disadvantageous results from planting seed from tapped trees are not known in any case. Such seed is in general smaller than that from tapped trees, and does not germinate so well. If injurious effects really follow the use of such seed, they are so little in evidence, that up to now they have escaped observation. They can in no sense outweigh the advantage which is derived from planting seed from tapped trees, i.e., the power to select seed from good yielding trees.

[We may add to this the following extract from Dr. Trimen's Report for 1880, referring to Cinchona :—

"Selected and marked or numbered trees should be analysed by a competent Chemist, and the results compared with the characters of the trees. Those with a good bark analysis should be kept as seed trees, those with a bad one ruthlessly destroyed. In this way alone it is possible after a few years to obtain seed which will come true. No pains should be spared in this matter. It is important that growers should realise that before long (assuming that quinine retains its commercial pre-eminence over the other alkaloids) it will be only the best barks that will secure good prices : the inferior must hang on hand, and only be disposed of at reduced rates."]

RESTING RUBBER TREES.

The Gazette de Hollande (April 4th) draws attention to a matter that would seem to have escaped that degree of the attention which its apparent importance renders essential to the well-being of all having important interests at stake in Mid-East rubber-producing countries. We refer

to the resting of rubber trees. Hitherto, it seems, managers have had to put forth strenuous efforts to get as much as possible out of the trees in order to gratify the desires of Boards of Directors bent upon piling up dividends. If only a fraction of all we hear be true, the danger arising from over-draining young trees has been increased a thousand fold of late owing to the "slump" and the consequent necessity of producing *as much as possible* in order to continue to show good profits. But there are limits to everything—even to the strain of its vitality which the rubber tree can bear with impunity—and the time seems to have arrived when the desirability of systematically resting rubber trees during the wintering season might with advantage receive very general and careful consideration. Among the latest advocates of systematic resting of the trees during the wintering season is Colonel Vansittart, who holds that if unanimity cannot be attained amongst Eastern rubber planters on so important a matter then it may be necessary for certain governments to step in to save plantation owners from themselves. "Why," he asks, "should not the Governments of Malaya, Ceylon, Sumatra, etc., be approached with a view to making tapping illegal during the wintering season for a month or two, and providing, further, that a breach of the regulations should render delinquents liable to a very severe penalty? Each country could choose for itself such time as is most suitable for that purpose, provided that *all countries observed the same length of time for resting trees.* Were this done, no one country would gain any advantage over another, while every plantation in the Mid-East would stand to *greatly benefit by the* yearly rest." Whether the resting period is brought in by legal measure, or voluntarily, there seems abundant reason for agreeing with Colonel Vansittart that it will have to come eventually if the industry is to be placed on the permanent and satisfactory footing it certainly should be the aim of plantation companies to secure for it as soon as possible. That most companies are inclined to favour the adoption of methods looking to so desirable a consummation has been demonstrated on several occasions in the not very distant past, and it will not be surprising, therefore, if the opportunity afforded by the forthcoming reunions of rubber planters, rubber manufacturers, and rubber authorities and experts of all kinds in London (in June) and in Batavia (in September) is availed of to give to the wintering question that degree of thought which its undoubted bearing upon the whole future of the industry would seem to call for if the trees are to continue as healthy and prolific as all shareholders in estates naturally hope they will be.

It would be interesting to know what the heads of the Botanical and Agricultural departments of the F.M.S. and S.S. think about this matter, and it is obvious that a useful purpose could be served by the publication at this juncture of their views both pro and con a regular resting season together with their ideas respecting the best way to render regulations of the kind suggested effective and beneficial without having recourse to special legislation.—Malaya Tribune.

MELONS IN SPAIN.

Melons in Spain are ripened for choice quality by removal from the vines and hanging in the sun and air. Some are kept for months in the dark, packed in sand or sawdust where light, moisture, heat, and frost cannot reach them. Some last through the winter hanging near the ceiling of a dark room.—World's Chronicle.

CACAO.

YOUNG CACAO PLANTS.

Mr. W. Cradwick, an Agricultural Instructor of the Jamaica Agricultural Society, writing to the Journal of that Society on the transplantation of young cacao plants, remarks as follows:—I am afraid when people are transplanting plants from bamboo joints to the field a good many of them are lost for the want of a very simple precaution. The earth and roots of the transplanted plants should be as wet as it is possible to make them, and before it is attempted to move the plants from the bamboo joints they should be thoroughly soaked in water, not merely watered with a pan, so that when the plants are put into the ground, even if a dry spell follows, it is not at all likely that the plants will die, as the wet earth round the roots will attract the moisture from the surrounding earth, whereas if a dry ball of earth is put into the soil it is an exceedingly difficult process to get it wet and one which takes a long time even in favourable rainy weather.

The greatest care should be taken to surround the young plants with nothing but the finest earth, which should be squeezed very tightly round the young plant so as to prevent an excess of dry air circulating between the earth in which the young plant was growing in the bamboo joint and the earth in which it is now being placed.

Water thoroughly, and to finish up the process take the trunks of banana plants, split these and place them around the young cacao plants. This will serve as an admirable mulch.

CACAO CANKER IN SAMOA.

The following account of cacao canker is extracted from an article in Beihefte zum Tropenpflanzer, April 1914, on cacao cultivation in Samoa, by Herr Ernst Demandt:—

Among economic trees, cacao is one of those most afflicted by diseases and parasites ; and in all cacao lands a constant fight is carried on against its enemies. It should not be surprising therefore, that in Samoa, where its cultivation is comparatively speaking, of quite recent origin, a number of its diseases and parasites have already established themselves. It is a well known fact that any intensive cultivation permits enemies of the crop to develop quickly. The combating of these enemies is, in reality, part of the work of cultivation, and is as necessary as any other work in the management of a plantation. Indeed, we would further assert, that it is the first duty of every planter to do his utmost to keep his plantation free from pests and diseases, both in his own interest, and in that of the whole country.

In comparison with other cacao countries, Samoa at the present day by no means suffers excessively from enemies of cacao. Apart from canker which is very dangerous and in consequence has been much written about,

we have no enemy of cacao, which could become permanently equally destructive. A tree, once attacked, can indeed be destroyed by one of these other pests, yet an epidemic spread of the same is to-day somewhat improbable, if the smallest beginnings are stamped out, and the pest thus rendered apparently "harmless." On a well managed plantation, however, there should be no "harmless" appearances of disease: the careful planter should always remember that from a harmless beginning an epidemic can develop. The best method of fighting a disease, and at the same time the most effective against an epidemic, is preventive hygiene on the plantation.

In this connection it is not a question of "talk of the devil and he will appear:" we would only point out that the planter is threatened by many enemies, and that it is of great importance to him to keep his crop constantly under close observation: only thus can he obtain what his trees should yield.

Naturally it is impossible to keep a plantation quite free from every enemy. The planter has it in his power, however, in each of our cacao diseases, even the most dangerous, to reduce the damage to a minimum which would not decrease materially the value of his estate, but would form a normal loss from "wear and tear" of cultivation, with which he should reckon as a matter of course.

The most dangerous disease of cacao is usually designated by the title of "canker." The name itself, which has been adopted from English cacao growing countries, was originally applied to diseases producing a canker: while, as interpreted to-day, it is not to be understood as tree canker, in the sense that one thinks of canker on fruit trees at home. The expression has become naturalised, and is so generally used in this country, that there would be no object in searching for an equivalent expression.

In the early days it was proposed to term the disease Bark-disease or Bark rot of cacao. This expression was correct, but it did not include the disease of the fruit. One must remember that, if one briefly says canker, this includes both fruit rot and bark disease, which however in Samoa may not be caused by the same agent. We will designate here the disease of the bark as Canker, that is bark rot, and the disease of the fruit as Brown-rot.

According to Gehrmann, the cause of Bark rot in Samoa is *Fusarium Samoense* Gehr, and that of the Fruit rot or Brown rot, a *Phytophthora*. Other investigators ascribe to Bark rot and Brown rot or Fruit rot the same cause, e.g., Rorer for Trinidad a *Phytophthora*, and Petch the same for Ceylon.

In the present account both diseases may be artificially included under Canker; the bark rot and the brown rot of the fruits will be considered together, as in practice it is of no importance whether two different fungi are the causes of the diseases, since their control and treatment are the same. In practice one sees, in fact, bark rot arising from fruit rot.

The attention of the cacao planter in Samoa was directed to the bark disease some years ago. Since 1904 it has been known as an enemy of cacao, yet for many years nothing was done to check it, not till the increased occurrence of canker hand in hand with the increase in cacao cultivation showed its dangerous nature more and more. There has been much dispute over its origin, whether it was introduced or came from the jungle. It is certainly agreed, however, that the cause of canker is indigenous to this country, as the representatives of these orders of fungi are indigenous to all the tropics: also that it has led a harmless existence on some other host before the introduction of cacao cultivation, and incidentally it does so yet.

In support of this assumption it may be mentioned that the cause of the Samoan bark rot, *Fusarium Samoense* Gehr., has not been found in other cacao countries: the appearance of canker, especially in the planting district of Apia, is not opposed to the above, for in that district is found generally the oldest and the bulk of the cacao of Samoa.

Up to the year 1912 canker was observed only on the stem, the sporadic appearance of brown rot on the fruit being overlooked. Not till the excessive rainy season of 1913 were the fruits attacked to any considerable extent, and at the same time experiments provided the proof that brown rot of the fruit, contrary to other assumptions, often forms the point from which canker of the stem develops in the same tree.

Samoan canker attacks trees over 4 years old, rarely under, generally on the stem and the main branches: brown rot attacks cacao fruits of any age or degree of ripeness, and the disease can proceed from the stem to the fruit as well as in the contrary direction from fruit to stem. The danger of infection with canker is very great, and it would, if left to itself, spread all over the trees on which it alights. On this point there is only one opinion among cacao planters, and, following them, in our regulations on the subject, and that is that canker, wherever found, should be combated by all means possible. Hence on every plantation, every tree should be under special inspection solely with the object of spotting this disease.

It is specially important to note that canker not only attacks cacao but also appears on *Hevea*, the other important cultivated plant of Samoa. In this tree the thin shelled fruits are especially attacked by brown rot. On the outermost fruit layer, which is barely 1 m.m. thick, *Phytophthora* appears very abundantly. It certainly does not damage the ripened fruit, but it prevents the natural splitting of the same, so that the diseased fruit remains hanging on the tree, and dries up. On the stem of *Hevea*, canker has been found only in very isolated cases: it is, as a rule, not nearly so dangerous to this tree, which has some power of resistance, as it is to cacao (*sic*). However, many thousands of diseased *Hevea* fruits remain hanging in any old *Hevea* plantation, and if the weather is dull and moist, there is great danger to the cacao growing under *Hevea* in mixed plantations. The destruction of cacao fruits and trees is therefore the greatest in such plantations as have cacao and Hevea standing close together—a fact which has been determined in other older cacao countries. (This is rather a reversal of the usual way of regarding such mixed plantations.—ED).

The author recommends as measures of control, excision of diseased areas and tarring of exposed surfaces, burning of diseased bark and trees badly infested, burning of diseased fruits, maintenance of a special "disease gang," spraying with fungicides (Lime sulphur wash) before the rainy season, etc.

FERMENTATION OF CACAO.

ARTHUR W. KNAPP, B. SC. LONDON.

(*Continued from page 453.*)

The temperature is the most important factor in securing a good fermentation. It is sometimes stated that there is a danger of the temperature rising too high, say above 60° C. (140° F.), but 51° C. was the highest emperature I found in Trinidad, and this is not objectionable.

In order to ascertain if it were essential that the sweatings should run away, I had some beans enclosed in a 1 ft. cubical box, made perfectly water-tight, and placed in the midst of similar beans in the sweat-box. Thus the correct temperatures were maintained in the water-tight box. When they were taken out at the end of six and a half days, those in the water-tight box were still sodden, and the pulp was not so dark as that in the beans fermented under ordinary conditions. On roasting, the resultant cacao was good in both cases, and almost equally so—that from the water-tight box was slightly more acid, and certainly a paler and brighter red. There was no development of that "hammy" flavour that is thought to be caused by leaving the beans soaking in their own juice. This experiment shows that the draining off of the sweatings is not of great importance under conditions of perfect cleanliness, and where the temperature is maintained. Under ordinary conditions, however, it is better to let the sweatings run away, as their presence lowers the temperature of the mass, and is apt to make the cacao sour.

IN THE LATER STAGES THERE MUST BE SUFFICIENT AIR.

In the later stages the oxygen of the air is needed to complete the fermentation. Oxygen is also needed to produce the brown colour. I attempted to get *more even* and *thorough aeration* by inserting upright in the mass of beans a number of bamboo tubes, from which the nodes had been removed, and the sides perforated. Warm air rose up these tubes, showing that circulation was taking place.

The beans so produced appeared identical with those fermented under normal conditions. On roasting they presented no differences. I ascertained later that horizontal tubes had been tried by three planters, two of whom thought they had obtained better cacao thereby. One of these used square wooden tubes, and abandoned them because the natives were always breaking them.

TEMPERATURE OF BEANS.

Hours in box.	With bamboo tubes (greater aeration) Degrees Cent.	Normal Degrees Cent.
16	28	28
24	29	29½
40	35	36
48	35	37
	Bamboos inserted here.	
64	49	49
72	48	47
88	46	48
96	48	48
112	48	50
120	48	51
136	51	50
144	50	50
160	47	47

(The freer passage of air would cause a cooling. The above temperatures are so similar that it becomes evident that sufficient heat must have been produced by the extra oxidation to compensate for this cooling.)

As a result of these experiments and observations, I recommend that no special device be made for aeration, but that the boxes be raised 6 in. above the cement floor, and so arranged that air can pass freely under them. At the same time the wind should not be able to blow directly on the bottom.

Air is not only a necessity for good fermentation, but the better circulation prevents the growth of mould.

THE BOXES MUST BE KEPT CLEAN.

This means that they will have to be periodically scraped, and should they at any time become mouldy, a lime wash is advisable.

THE SWEAT-BOXES.

Iron nails are objectionable, because they stain the beans black. The tannin compound in the beans combines with the iron (which has passed into solution as acetate in the sweatings) to form a compound similar to ink. Iron nails should be hammered in from the outside. Copper nails or wood pegs should be used, if available. The corrugated iron of the *roof*, if freely exposed, is very slowly corroded by the acid vapours from the sweat-boxes. The cement of the floor is slowly dissolved away by the acid sweatings—asphalt would wear better. Glazed earthenware channels (which are said to be used in Surinam) would be an advantage if anything is to be done with the sweatings.

Double Walls.—The object of this is to form an air-blanket between the beans and the outside air and to allow of aeration all round; incidentally, it strengthens the building by removing the outward pressure on the side walls.

Size of Sweat-box.—I recommend a box 4 ft. × 4 ft., because with a mass of beans this size fermentation proceeds without encouragement. If a larger size is used, it not infrequently happens that one day's picking does not fill the box; consequently, the following day's picking is added to it, and perhaps even a third day's picking; so that with such a mixture it becomes impossible to obtain an even ferment. The planters appear to think that, if the beans are not covered, fermentation will not commence. The fermentation of large masses of beans cannot be prevented in this way.

(*To be continued.*)

THE BUDDING OF CACAO.

During a recent visit to the Government Experiment Station at Trinidad, the attention of the writer was directed to several rows of cacao plants in bamboo pots, which had been successfully budded. The spectacle of the healthy growing shoots on the brown leafless stocks would be sufficiently pleasing and interesting under most circumstances from a horticultural point of view alone, but at the present time, when uniformity and good quality figure so prominently on the market as the essential requirements of the cacao industry, the botanical features of this form of propagation fade before the economic. It will be well, however, before proceeding to discuss the commercial significance of cacao budding, to present, in brief outline, the work that has been done and the success that has been attained in this direction during the past year or two in the West Indies and elsewhere.

It may be remembered that during 1912, articles appeared in this journal which signalized the successful budding of the mango and avocado pear in St. Lucia and Dominica, and the result of this work may be taken as having provided encouragement for the still greater achievement attained during the same year in Dominica in the matter of budding cacao. The method principally employed in Dominica was patch-budding (which had proved successful for the mango), but whilst the experiments showed that budding in bamboo pots could be successful, it was found to be by no means easy, and much remained to be learned by further observation and experiment; especially was this the case with regard to the T-method of budding. In Trinidad and Dominica, the success which has already been achieved has arisen slowly, and it has been found that good results depend largely upon the experience of the operators. In both these Colonies, the Departments of Agriculture maintain a decidedly optimistic attitude towards the possibilities ahead of budding cacao, and there seems little doubt but that the operation will soon find itself included in estate practice.

Below will be found a short article describing the budding operation as carried on in the Philippines. In this territory, the vegetative form of propagating cacao by budding has met with remarkable success. Over 90 per cent of the stocks budded by the T-method were successful in a recent experiment; and although this work was done under nursery conditions, it seems improbable that with reasonable care it would be less satisfactory in practice. It is confidently believed that no cacao grower who has acquired the art of shield-budding, and who follows the instructions given in the article referred to above would hereafter have to crop a heterogenous lot of seedling trees. In the editorial which preceded the special article under consideration, we are told that 'by following the new method now placed before the public ..... the planter can select his variety and at the same time propagate from his most prolific trees of that variety, so that within two years from placing of his buds, he will have changed his plantation from a haphazard mixture of several varieties and from a collection of good, bad and indifferent trees to a regulated plantation, having one, two or three varieties, all the trees of which are known to be heavy producers.'

The significance of this uniformity can be easily imagined. Instead of having one tree bearing 200 pods, and another near by with perhaps only ten, both will be prolific. This is certain, for it has been proved in Trinidad that the degree of prolificacy of individual trees is constant from year to year and probably hereditary. The degree of prolificacy can therefore without fail be maintained by vegetative propagation. Again, another very important aspect is that by increasing the average yield per tree, the same crop can be obtained from a smaller area of land than hitherto, which is a very significant matter in relation to cacao as a crop for the peasant proprietor. Lastly, there is the benefit which will be derived through the improved uniformity in the quality of the beans; this will simplify fermentation and most certainly lead to higher prices being obtained on the American and European markets.

Whereas grafting by approach—which has until lately figured as the only satisfactory way of propagating cacao vegetatively—presents difficulties in connexion with estate work, the new method of budding seems to be perfectly applicable. The land is cleared in the ordinary way, the seed of any hardy variety planted at the usual distances, and when the seedlings are about a

year old, the operators—boys who have been specially trained—are sent round with freshly obtained material from selected trees and the operation performed. There are no stages to be built around the trees, and no special watering is required as in the case of grafting by approach.

The question of getting the skilled labour has to be considered, but this need offer no anxiety since it requires but a few weeks for boys and women to become expert at the work, under proper supervision. It would seem desirable for the various Experiment Stations to give special attention to the training of youths in the shield-budding of cacao. It might be possible, in fact, to arrange a series of short courses at the Stations to which estates could send any one of their employées for the purpose of getting proper instruction. Again, the secondary and elementary schools which have gardens should pay special attention to the matter. Even if the practical instruction which it may be found possible to give does not immediately find application in practice, the importance of the matter will have been emphasized and a larger circle made familiar with the existence of the method and its great possibilities in the development of the cacao-growing industry.

RECENT WORK ON THE BUDDING OF CACAO.

Although a considerable amount of work has been done on the vegetative propagation of cacao, especially in Dominica where attempts to graft by approach and to propagate by means of patch-budding have met with considerable success, it is only quite recently that the process of budding known as shield or T-budding has answered satisfactorily. This has occurred in the Philippine Islands ; and a paper on the results that have been achieved, appears in the Philippine Agricultural Review, for January, 1914.

It is stated in this that the results, so far attained with this kind of budding, have been so uniformly satisfactory on a small scale that it seems highly improbable that the results in larger practice will be different, and it is confidently believed that no cacao grower who has acquired the art of shield-budding, and who follows the instruction given in the following paragraphs need hereafter crop a heterogenous lot of seedling trees. He can work over his entire estate to any single desirable variety, and every budded tree will bear cacao of exactly the same quality. The operation itself is simple, requires a minimum of propagating material, and is easily and rapidly performed.

After explaining the principles of vegetative propagation and the preparation of grafting wax and tape, the author gives the following instructions :—

'The budding operations should be performed in the following order First make a vertical incision in the stock, about 15 to 20 centimetres above the ground : then, at the lower end of this incision, make a horizontal cut so that the resulting wound resembles an inverted L ; then, in order to facilitate the insertion of the bud, make a sloping cut upward, below the horizontal cut, and also lift the bark by passing the point of the blade under the bark upward along the vertical incision, loosening the bark sufficiently to allow the bud to slip into place easily ; now cut a bud not less than 4 centimetres long, by passing the knife *diagonally* under the bud, taking special care that it is not cut too thin and that the tissues do not split or tear, which is liable to occur if the knife is dull or if it is held at too great an angle to the bud stick ; as a further precaution it is well to hold the tip end of the bud stick toward the

body in the act of cutting the bud ; now insert the bud and tie firmly, without strangling, with waxed tape, beginning at the point of insertion and covering the entire incision so that no water can enter.

'Fourteen to eighteen days after the buds are inserted, the buds should be examined, and where they have taken, the tape should be unwrapped to below the leaf scar and the stock should be "lopped" about 10 centimetres above the bud. This is done by cutting through the stock about one-half to two-thirds with a knife or a pruning saw and bending the tops over. The budded plants should hereafter be examined once every ten days and all wild sprouts on the stock rubbed off. This work is most important, for if it is not attended to, the stock sprouts rapidly gain the upper hand at the expense of the bud, which frequently under such circumstances fails to grow at all. When the bud has made a growth of 30 or more centimetres, according to the size of the stock, and the wood is well ripened, cut off the stock immediately above the bud union. Paint the wound carefully with white lead or some other oil paint in order to exclude borers and fungi. If the buds fail to make straight upright growths they should be staked and tied ; split bamboo stakes are very serviceable for this purpose.

'Large seedlings may, of course, be top-worked by heading them back and budding the young sprouts.'—The Agricultural News.

THE PREVENTION OF MOULD.

During the last ten years, the United States Department of Agriculture has tested a large number of chemicals with regard to their employment for preserving wood. In general, the experiments have been conducted by immersing wood in tanks, filled with a solution of the chemical in water. For treating building timber, Sodium bicarbonate in a five to eight per cent. solution is the most economical and satisfactory. Corrosive sublimate solution, with the addition of Hydrochloric acid to make it more permanent, gave good results, but solutions of corrosive sublimate are too poisonous to be used on a large scale. Lime compounds, although they prevent discolouration of the wood, are not to be recommended if the wood is to be used for industrial purposes, since the lime has a tendency to harden the surface and so make it difficult to work. A lime sulphur solution, made by adding five lb. sulphur and five pounds lime to fifty gallons of hot water, gives good results with veneer, since it bleaches and prevents discolouration, but further experiments are required with this mixture before it can be fully recommended. Rapid drying after treatment, preferably in a drying oven, is an important factor.

COCONUTS.

COCONUT BUD ROT.

With regard to this disease in Surinam, the Department of Agriculture of that country states that though spraying with Bordeaux mixture does not absolutely cure the disease, it exerts a favourable influence. The cost of spraying varies according to the size of the plants. For trees, five to ten years old, it is about 15 cents per tree, for older trees 18 cents, and for younger trees correspondingly less [? dollar cents.—Ed]. Well developed ten year old palms require seven to eight litres of Bordeaux mixture each.

STATEMENT OF COPRA AND COCONUT OIL EXPORTED FROM CEYLON

From 1840 to 1910.

Year.	COPRA.		COCONUT OIL.	
	Quantity.	Value.	Quantity.	Value.
1840	Cwt. 6,665	£ 2,507	Glns. 475,742	£ 32,481
1840–1	,, 3,639	,, 1,458	,, 321,965	,, 24,061
1841–2	,, 8,419	,, 3,020	,, 475,967	,, 34,242
1843	No books in Record Office			
1844				
1845	Cwt. 10,562	£ 3,175	,, 282,186	,, 15,944
1846	,, 13,829	,, 5,506	,, 123,980	,, 7,938
1847	,, 14,811	,, 6,503	,, 197,849	,, 18,541
1848	,, 33,535	,, 12,638	,, 311,526	,, 24,838
1849	,, 29,360	,, 7,819	,, 513,278	,, 34,831
1850	,, 11,305	,, 4,165	,, 407,959	,, 35,035
1851	,, 27,026	,, 9,678	,, 443,698	,, 31,444
1852	,, 39,173	,, 13,325	,, 749,028	,, 58,045
1853	,, 37,577	,, 16,183	,, 1,033,973	,, 95,990
1854	,, 52,841	,, 30,200	,, 1,059,272	,, 121,297
1855	,, 27,296	,, 16,586	,, 908,742	,, 108,913
1856	,, 29,910	,, 16,446	,, 1,046,326	,, 101,590
1857	,, 19,554	,, 11,627	,, 1,679,258	,, 212,184
1858	,, 32,609	,, 19,565	,, 62,450	,, 77,716
1859	,, 10,081	,, 6,049	,, 95,515	,, 118,864
1860	,, 13,766	,, 8,260	,, 124,480	,, 154,909
1861	,, 27,279	,, 16,368	,, 83,605	,, 104,043
1862	,, 19,595	,, 11,757	,, 114,873	,, 142,953
1863	,, 33,723	,, 20,234	,, 150,967	,, 187,853
1864	,, 29,326	,, 17,795	,, 180,755	,, 224,947
1865	,, 11,998	,, 7,199	,, 94,563	,, 120,678
1866	,, 55,569	,, 33,032	,, 83,800	,, 104,400

STATEMENT OF COPRA AND COCONUT OIL—*Contd.*

Year.	COPRA.		COCONUT OIL.	
	Quantity.	Value.	Quantity.	Value.
1867	Cwt. 23,302	£ 13,981	Cwt. 108,119	£ 134,548
1868	,, 5,338	,, 3,203	,, 114,416	,, 142,385
1869	,, 17,648	,, 10,589	,, 103,826	,, 129,206
1870	,, 40,638	,, 31,678	,, 135,658	,, 170,211
1871	,, 50,573	,, 44,625	,, 207,136	,, 257,519
1872	,, 41,751	Rs. 277,389	,, 278,216	Rs. 3,306,891
1873	,, 34,461	,, 190,868	,, 113,871	,, 1,418,183
1874	,, 29,362	,, 188,417	,, 145,078 and 21 packages.	,, 1,806,629
1875	,, 8,021	,, 50,264	Cwt. 123,854 and 9 packages.	,, 1,541,722
1876	,, 28,115	,, 174,196	Cwt. 212,971 and 32 packages.	,, 2,653,162
1877	,, 19,593	,, 158,637	Cwt. 132,740	,, 1,651,880
1878	,, 45,705	,, 398,592	,, 175,423	,, 2,183,052
1879	,, 64,862	,, 529,651	,, 218,389	,, 2,717,739
1880	,, 92,761	,, 912,489	,, 352,479	,, 4,386,414
1881	,, 54,139	,, 365,474	,, 201,566	,, 2,508,378
1882	,, 95,837	,, 716,834	,, 210,954	,, 2,625,207
1883	,, 171,049	,, 1,496,239	,, 348,381	,, 4,335,420
1884	,, 202,203	,, 1,644,332	,, 383,955	,, 4,778,115
1885	,, 161,710	,, 1,277,003	,, 265,183	,, 3,300,065
1886	,, 156,519	,, 1,377,401	,, 277,311	,, 3,450,985
1887	,, 136,346	,, 1,070,561	,, 323,445	,, 4,025,098
1888	,, 147,355	,, 1,254,904	,, 364,116	,, 4,531,222
1889	,, 54,961	,, 429,415	,, 379,934	,, 4,728,102
1890	,, 156,194	,, 1,480,817	,, 368,724	,, 4,588,561
1891	,, 68,907	,, 921,384	,, 426,669	,, 5,309,665
1892	,, 169,073	,, 1,625,085	,, 564,550	,, 7,025,412
1893	,, 77,561	,, 1,163,025	,, 387,905	,, 6,034,072
1894	,, 45,441	,, 576,721	,, 448,573	,, 6,977,793
1895	,, 31,716	,, 371,571	,, 418,990	,, 6,517,627
1896	,, 50,257	,, 496,618	,, 390,813	,, 1,079,295
1897	,, 115,466	,, 1,128,244	,, 488,342	,, 6,382,629
1898	,, 512,062	,, 4,984,301	,, 467,326	,, 6,107,947
1899	,, 315,787	,, 3,164,751	,, 430,527	,, 6,061,815
1900	,, 399,806	,, 3,908,114	,, 468,274	,, 6,672,902
1901	,, 451,825	,, 4,490,513	,, 474,188	,, 7,601,233
1902	,, 377,235	,, 4,095,057	,, 551,391	,, 10,007,751
1903	,, 731,329	,, 7,525,427	,, 687,623	,, 11,022,596
1904	,, 722,834	,, 7,971,993	,, 510,958	,, 9,197,244
1905	,, 390,587	,, 4,896,569	,, 587,421	,, 9,815,804
1906	,, 446,018	,, 5,633,600	,, 539,002	,, 9,545,725
1907	,, 382,328	,, 5,297,603	,, 478,573	,, 11,830,324
1908	,, 748,319	,, 8,351,077	,, 644,314	,, 11,984,240
1909	,, 783,797	,, 10,000,428	,, 599,795	,, 13,141,508
1910	,, 758,711	,, 12,697,725	,, 619,680	,, 17,326,252

We owe the above table to the courtesy of the Principal Collector of Customs, who has caused it to be compiled at the request of MR. F. LEWIS for the information of the Congress of Tropical Agriculture in London.—ED.

PLANTATION INTERESTS.

Wispy puff paragraphs on coconuts are again appearing in the daily press; both the *Eastern Palm Estates and Trading Syndicate* and *The Western Coconut Estates* should be steered clear of. The balance sheet of several coconut wild cats floated last year should be published shortly. Meanwhile Eastern press and Eastern planters have at last started exposing the pretensions of the writers of the so-called standard works on coconuts.—Investor's Chronicle.

BAY OIL.

There has been no lack of sufficient supplies during the last few months, and it has therefore been possible to reduce the price. Besides the exquisite West Indian qualities, however, parcels of bay oil were imported occasionally which had been adulterated with oil of cloves and pimento to a degree which made identification almost impossible. As we have ascertained that these parcels have found buyers in the European market, we would warn the trade against allowing the price to be the principal guide to buying. By using such oil as described above many a bay-rum manufacturer has already lost his, reputation and his customers. Our terpeneless bay oil continues to enjoy the keenest possible demand, and is particularly useful for manufacturers to whom the limited solubility of the natural bay oil offers an obstacle in the making of their preparations.—Report of Schimmel & Co. April 1914.

PHILIPPINE OIL-NUTS.

According to an American consular report, the Bureau of Science of the Philippine Government at Manila is making an investigation of a new oil-bearing nut that has been discovered on the island of Catanduanes, whence the nuts were forwarded by natives under the impression that they were candlenuts (lumbang nuts). The nuts have yielded 45 per cent. of oil, which has been tested successfully in soap making. The nuts so far have not been exactly identified, though the Bureau reports that they belong to the family *Meliaceæ*. genus *Amoora* or *Dysoxylum*. The dry nuts yield 45 per cent. of a dark fatty oil that makes a good commercial grade of soap. It is of a non-drying character and is said also to be unsuited for edible purposes. The nut and its possibilities are being further investigated by the botanical and organic chemistry divisions of the Bureau of Science. The manufacture of coconut oil from Philippine copra at Manila has not only come to the front rapidly in the last year or so, but there is a strong movement in Manila for the manufacture of various advanced products from the oil. The exports of the oil from the Philippines in 1912 amounted to 1,450 lb., valued at $ 40 gold; the exports in 1913 amounted to 11,022,064 lb., valued at $ 1,146,339. In 1912 the average price for the oil in Manila was 2·7 cents gold per lb., while in 1913 the average price was 8 cents per lb.—Chamber of Commerce Journal.

RICE.

RICE CULTIVATION ON DRY GROUND.

M. A. FAUCHERE.

M. A. Fauchere writes as follows on the above subject in a recent number of the Journal d'Agriculture Tropicale.

"In the last number of The Journal d'Agriculture Tropicale I drew the attention of the producers of Brazilian coffee to the possibilities of associating rice cultivation with that of coffee, in the 'fazendas' possessing suitable soils.

I wish now to suggest to them to attempt rice cultivation on dry ground as I had an opportunity of doing at Tamatave, not without success.

Rice is considered as a marsh plant (*Oryza sativa*) or as a montane plant (*Oryza montana*), this latter being cultivated in forest clearings, as unfortunately is done by the natives of nearly all tropical countries.

In 1906, being at the Experiment Station of Tamatave, I had the curiosity to attempt the cultivation of rice on dry land, previously prepared as for sowing wheat.

For this trial I employed four varieties of rice which the natives ordinarily cultivate in flooded rice fields. They are named in Malagasy: Angaziza; Betahava; Fotsy Ansaka; Be.

The tract of land chosen for this experiment had an area of 125 ares. It was an alluvial plateau, situated about five metres above the level of the River Ivoloina, which traverses the Experiment Station of Tamatave: it is very exceptionally inundated. Without having been subjected to any work of drainage, it is at this moment occupied by cacao three years old, which shows very good growth.

Before sowing, the ground was ploughed three times with the double plough, at intervals of two months in the first six months of 1906. It received no manure.

The sowings of the rice, broadcast directly with 70 kilos of paddy per hectare, were carried out toward the end of the month of August. The sowing was covered up by harrowing strongly.

During the month of September and a part of the month of October, there was great drought, which destroyed a certain quantity of the rice plants, to such an extent that at one time the experiment appeared doomed.

Rain fell at the end of October, and the rice recovered with extraordinary rapidity. The plants tillered abundantly and attained such a size, that in the variety Angaziza a man of average height was completely hidden.

At the harvest, this variety and the Betahava were so well developed, that the soil was completely covered with very thick sheaves.

The duration of the crop was: Be, 179 days; Betahava, 171 days; Fotsy Ansaka, 149 days; and Angaziza, 153 days.

The yields in paddy per hectare were the following:—

Be	...	3,330 kilos	Betahava	...	3,640 kilos
Fotsy Ansaka		3,430 „	Angaziza	...	4,330 „

Since that time rice has been almost regularly cultivated in dry fields' each year, at the Experiment Station on the Ivoloina.

It is certain that this method of cultivation applies only to deep soil, which remains cool. These are the characteristics of the coffee lands of Brazil, notably of the 'roxa' lands, whose fertility I could appreciate in the admirable 'fazendas' of the region of Riberao Preto.

It appears to me that the cultivation of rice carried out as indicated above, would succeed perfectly in these soils, and would be the more advantageous as, cultivated on dry land, this cereal would much more readily give rices devoid of black grains, which depreciate completely those rices destined for human consumption.

Finally, in these conditions, rice cultivation would enter easily into the varied succession of crops, and could take its place in the rotations with tobacco, cotton, sugar cane and diverse other plants.

For the States producing Brazilian coffee, if it was desired to make a trial of rice cultivation on dry ground, it would be necessary to employ quick growing varieties, and sow them in the first or second fortnight of October, in order to harvest in March and April.

It should further be mentioned, that if this method of rice cultivation becomes general, it would permit of the use of agricultural implements, sowing machines, reaping machines, thrashing machines, etc., which are very difficult to employ in flooded rice fields."—Journal d'Agriculture Tropicale.

Note: 125 ares=about 3 acres.

THE IMPROVEMENT OF RICE BY SELECTION IN JAVA.

By Dr. J. VAN BREDA DE HAAN

When the Department of Agriculture was formed in 1905, attention was soon directed to the study of the cultivation of rice, and the improvements which might be effected with regard to yield.

Among the Divisions of the new Department, there was established a Laboratory for Investigations in Rice and Allied Cultivations: this Laboratory was to deal specially with the question already referred to, and to discover how the cultivation of rice might be improved in the most rational manner.

It was necessary to take up several lines of investigation. Thus a study of the characters of the rice plant was undertaken, and of the diseases which attack it. Then the conditions under which rice had hitherto been cultivated in Java had to be examined, as well as the different factors,—composition of the soil, application of manures, and irrigation—which could exercise any influence on the development of rice.

On the other hand, it was sought to effect an increase in yield by means of selection, and cultures in pure lines. The measures adopted, as well as the biological studies which have arisen in consequence, will be discussed in the following pages. From this it will be seen how the study of the rice plant was begun, and what results have been obtained after six years of continuous work.

In 1907, a field of 10 hectares with a laboratory and seed stores was set apart for selection experiments at Buitenzorg, and several officers were appointed specially for this work.

Before the creation of a Department of Agriculture, little or nothing had been done for the improvement of seed. Trials had been made in selection by density, but these trials, which will be discussed later, were not made in a rational way, and consisted only of a separation of full and empty grains, which was carried out in some districts before sowing.

In spite of the small attention devoted to the selection of seed the native rice fields are, in appearance, fairly uniform, due in great measure to the fact that the cultivator harvests each ear separately. Often he chooses the best filled and most regular ears before harvest, to provide the seed for the next season. By this crude selection, he obtains fields, evidently composed of different types, but fairly regular in appearance.

TYPES OF JAVA RICE.

In view of a rational selection, it was first of all necessary to gain as complete a knowledge as possible of the different species and varieties of rice which are cultivated in Java. From all parts of Java, the laboratory procured samples of paddy, with notes of the local name of the variety, whether it was cultivated dry or wet, and whether it ripened early or late: the time of ripening varied sometimes by one or two months in different varieties.

In this way, there were collected, for Java, 6,400 samples of paddy, and Mr. J. P. Moquette was entrusted with the important work of reducing to some sort of order this enormous number of specimens. With this object, he carried out a rough selection based chiefly on the external appearances of the ears, the grain, the awns, and other factors, after having divided them all (received in the form of sheaves) into two groups, viz., rice and Ketan (*Oryza sativa* and *Oryza glutinosa*).

To separate rice from Ketan, each sample must be examined by cutting the grains in two, and placing them in a dilute solution of Iodine. In the case of rice the section is coloured dark violet, in Ketan, red brown.

After this provisional separation of the samples, they were divided into

1. Varieties with dark glumes and awns
2. Varieties with red awns
3. Varieties with yellow awns
4. Varieties without awns.

These groups were separated into varieties with white, red, or black grains, and those with opaque or translucent endosperm.

In this way, the samples of paddy received were divided into 751 different groups of rice, and 141 of Ketan, all of which differed more or less from one another in their external appearance.

A type collection and a genealogical register was instituted for these different groups: each variety is there described in detail, with a record of the external characters which distinguish it.

TESTING TYPE FORMS.

In the classification described, account was taken only of external characters. As some of these characters probably depend on the soil and climate of the district in which the plants grew, all the different types were sown under identical conditions on inundated fields so that a comparison might be made. By repeating this experiment every year, it will be possible to determine what characters are constant, or how far these characters depend on external conditions.

Specimens are preserved every year: in that way it is possible to make comparisons between them.

When, after several years of cultivation, the permanence of certain external characters has been determined, it is not necessary to retain more than the specimens collected in the first three years.

These investigations were carried out in part by M. Moquette; from the middle of 1906, they were continued by M. J. E. Van der Stok.

By cultivating samples apparently homogeneous, one is able to determine, by examining the various characters of the plants, that the majority of the samples are really composed of several very distinct types. In order to obtain a more thorough selection one must begin with a pure culture (pedigree culture). To determine whether it is necessary to employ direct pollination, and whether one ought to start with a single grain or a panicle, some preliminary investigations must be made.

THE FLOWERING OF RICE.

Kornicke deduced, from his observations on the flowering of rice in Europe, that the plant is adapted for cross fertilisation and that the flowering period lasts all day.

From observations made at Buitenzorg it appears that the flowering period lasts at most an hour and a half and that the flowers, in general, open between ten and eleven in the morning.

The separation of the glumes and the extension of the stamens takes place very slowly.

In sunny weather, about ten minutes elapse from the moment when the glumes begin to separate until the extension of the stamens is completed. Pollination has often occurred when the stamens are scarcely half-developed, that is to say, when they are still within the flower.

In certain cases,—and in some varieties it is the rule,—the glumes separate only for a very short time and the stamens remain entirely enclosed within the flower. It seems that the stigmas only appear after the extension of the stamens has been more or less completed.

From what has been stated, it will be evident that direct pollination is possible in the case of rice, and this is also shown by experiments in which the glumes are prevented from opening so that the flower must be self-fertilised. The seeds produced in this way have been sown and appeared to germinate normally.

In addition, it has been found that the pollen of rice is only carried for short distances, a fact which has been readily demonstrated, for example, by sowing glutinous rice by the side of ordinary rice. (In the Philippines it is considered sufficient to leave a space of one metre between the plots of different varieties to avoid hybridisation.)

Cultivation of the samples of 05/06 and 06/07 has shown that the plants arising from the grains of a single panicle are in general practically homogeneous and has thus proved that pollination between neighbouring plants is very limited.

From the results of these experiments, and also in order to obtain the more rapid multiplication of seed, which is possible if the culture is begun not from a single grain but from a single panicle, it has been provisionally decided to begin with the panicle as the point of origin of the cultures of the different numbers of the register.

In order to secure a more complete separation of those groups which, in the register, appeared particularly good, cultivation in pure lines starting with a single grain was adopted.

CLASSIFICATION.

The study of the types of the botanical species *Oryza sativa L.* has led to their division into four groups which may be denoted by the letters A,B,C, and D. A and B together form the group *Communis* of Körnicke; C is identical with the group named by Körnicke, *Minuta* Fresl.; and D with the group *glutinosa* Lour.

Groups A, B, and C comprise the types of starchy rice. In the varieties included in group D, the power of transforming the carbohydrates into starch in the endosperm has been partly lost, and these varieties may be considered retrogressive.

Group A contains the varieties known in Java under the name of "Tjere-padi," which are almost without awns. The blade of the leaf generally bears hairs which are soft to the touch and very thick. On the glumellae, the hairs are notably shorter than in the representatives of Type B. The grain of A is generally smaller than that of B, the length of the panicle is also less, but the number of stems is greater.

The stems are more slender and weaker in A, and consequently the varieties belonging to this type show a greater tendency to lie on the ground. Varieties of the group C all have very small and round grains: in their other characters they resemble B.

Between these different types, transition forms, which are probably due to hybridisation, are met with. Van der Stok has carried out researches to discover whether any correlations exist between the different characters, and has found that in group B all the types which have a covering of short and rough hairs are early types. The late ripening types of group B have long hairs on the leaf, and, in general, are cultivated on irrigated lands, while the former are grown on dry lands.

PEDIGREE CULTURES.

As has already been stated, in addition to the cultivation of the varieties enumerated in the register by starting with panicles identical according to their external characters, plots have also been established as pedigree cultures

beginning with a single grain. In this way, it has been possible to obtain, from a plant apparently quite uniform, three races which differ in the average size of their grains and in the number of grains in each panicle. That has proved that a judgment based solely on external characters is not capable of giving a complete idea of all the differences which may exist.

In view of the results obtained, pedigree culture (pure lines) were begun, of varieties which had given good results but had not been subjected to selection in order to obtain absolutely pure types.

It is clear that many years of work are required to secure a selection and improvement of the rice plant by the methods indicated. It is not sufficient to cultivate pure lines, starting from a given type of paddy, but these must also be compared with one another in respect of their yield, quality, etc. This demands a large amount of seed.

This selection by the method of isolation of pure strains has been carried out in the case of the paddy "Tranggerang," (originally from Carolina whence it was imported fifty years ago) and with several other varieties. Preference has been given to types which were noted for their good qualities in their native country.

For this reason, in the case of Tranggerang, plants with large grains and a good yield have been chosen, out of its different types, as the starting point.

The results obtained on the trial fields at Buitenzorg have been very satisfactory. Pure lines have been cultivated which yield 76 piculs of rice per bouw (2·6 tons per acre).

Every year these comparative trials of pure lines have been repeated, with the addition of varieties of the preceding years for the sake of comparison.

POPULARISATION OF RESULTS.

The results have been published every year, and the surplus seed has been placed at the disposal of those who desired it, at a moderate price. Several plantations which are particularly interested in the cultivation of rice have equally grasped the utility of this method of selection. Under the direction of the Department of Agriculture they have established trial fields where, among others, pure lines of the varieties of rice already found on the plantation are cultivated, and have obtained equally good results. For instance, they had a type of paddy which gave a good yield, but ripened very irregularly. By cultivation in pure lines this fault has been remedied, and a type has been obtained which possesses, in addition to other good qualities, that of ripening uniformly.

In their various tours, the officers of the Department of Agriculture have collected samples of types of paddy which appeared to be the best in a given locality. These have been planted in the Experiment Station, with the result that the collection there now numbers 800 types of paddy and 150 of Ketan. On continuing their cultivation, certain types will prove to be constant, while others will exhibit properties which make them less fitted for cultivation on a large scale : by this means it will be possible to practise further selection after a few years.

In order that the results may be of immediate application to the cultivation of rice in Java, it is proposed to establish seed farms in several districts of the Island, since the results which have been obtained up to the present by a comparison of pure lines with one another only hold good for lands which are subject to the same conditions of climate, soil, and irrigation as the selection plots at Buitenzorg. It has on other occasions been observed that some varieties of rice are very sensitive to changes in these conditions, especially as regards their time of ripening, yield, etc.; and it has rightly been remarked that figures of yield obtained at Buitenzorg ought not to be considered rigorously applicable everywhere. This has been fully understood by planters, and they have begun on their own lands to cultivate plants for seed production in accordance with the system of isolation. The same method must be employed by the Government, if it desires to work in the interest of the native cultivator.

In the seed farms, the cultivation of the varieties of rice which exist in the immediate neighbourhood, and form the "population," must be undertaken, then the culture in "pure line" which will lead to a selection of the better types, the seed of which will be subsequently distributed under certain conditions to the natives.

The selection plots at Buitenzorg will afford the necessary information, but the aim of the Station will always be primarily the elucidation of the scientific side of the question of selection and the importation of new varieties from other countries.

A beginning has already been made in the latter by the importation of varieties of rice from the West Indies and Japan.

A West Indian variety which gives a good yield has been grown in pure line, but its grain is too easily detached from the ear. The Japanese varieties flower too early in the climate of Buitenzorg and give scarcely any yield.

HYBRIDISATION.

In addition to cultures of pure lines, VAN DER STOK studied also the question of the hybridisation of rice in order to ascertain whether it was possible to obtain by seed plots fixed races of rice. This study could only be undertaken after a sufficient quantity of material in pure line had been obtained.

For castration, panicles due to flower the same day are selected, and after cutting off the extremities of the glumes of each flower the stamens can be easily removed. The ovaries then acquire an abnormal length and must be protected against external injuries. The aim of the selection of hybrids must be to obtain favourable combinations of several characters which are of practical importance.

In the first place, it is necessary to determine the manner in which the different characters behave in the generations obtained by crossing.

It has been found that if a variety of rice with a red skin is crossed with one which has a white (uncoloured) skin, or one with small grains (group D) with one with large grains (groups A & B), or ordinary rice with glutinous rice, a separation of the characters takes place in the descendants in accordance with MENDEL'S laws. A cross between a type with awns and a type without awns departs more or less from these laws.

In general, the selection of hybrids has not led to the rapid production of any practical result. The separation of characters appears to be effected in a somewhat irregular manner in the hybrids of rice, and extreme caution would be required in estimating the permanence of any hybrid type.

In his publications, Van der Stok has not neglected to bring forward the fact that a rapid degeneration is to be apprehended if too much reliance is placed on the constancy of a type, since there can exist within the type a scarcely perceptible variability which may be the source of a host of morphological differences, minute, but important as far as regards the value of the type for cultivation.

As already stated, natural crosses occur in the case of rice, and investigations have been made as to the extent of this.

For this purpose, 585 panicles of the different numbers of the register were sown side by side in '07-08. Among the plants grown in this trial, 52 panicles were found with one or more hybrid characters. In spite of the favourable conditions for crossing, the number of hybrids was thus very small.

In practice, it is often difficult to recognise directly whether one has to deal with a hybrid or not, especially when the characters of the mother plant predominate. It is only the second generation which permits a conclusion to be drawn, and that only if it reveals a separation of characters.

Hybrid plants are generally noticeable by their stronger growth and greater development. They may often be recognised in the field in that way.

It is possible that cross fertilisation occurs more readily with one variety than another.

As already stated, the pollen of the rice plant is only transported for a short distance : possibly the distribution of a variety in the field will influence in some degree the frequency of hybridisation.

To make certain that one is dealing with a natural hybrid, the descendants of the plant must be studied. The plants obtained in these trials nearly always show separation of characters which demonstrates their hybrid origin.

These investigations show that in the case of rice, self-pollination does not occur to the same extent as in barley, oats, or wheat, but that it is however more frequent than in plants known for their self fertilisation, such as tobacco and *Vigna sinensis*.

Van der Stok has further shown that in actual cultivation, the " populations " ought to be regarded as very mixed, and that hybridisation between different types will play an important part in determining the composition of these populations.

THE BIOLOGY OF THE RICE FLOWER.

In connection with his investigations on cross fertilisation, Van der Stok has studied the biology of the flower. When the flower opens, the glumes are forced apart by the swelling of the lodicules which absorb water. After a certain time, the lodicules give up their water, lose their turgescence, and the flower closes.

The time which elapses between the opening and closing of the glumes, besides being dependent on some external conditions, is very variable for different varieties and types of rice.

Some observations made on this point in the case of the variety Skrivinankotti show that an average period of 53 minutes is required for the opening of the flower. The shortest time was 35 minutes and the longest, 90 minutes. In the types R. 51 and R. 15 the period was 61 and 49 minutes respectively.

On the average, 3 minutes elapse from the opening of the glumes until the moment when the anthers begin to split and shed their pollen. After 5 minutes, the stamens are already flaccid and the anthers bent over.

The time of flowering has also been determined. The general opinion was that it took place during the night, but more exact observations have shown that that idea is quite incorrect.

Under the climatic conditions which prevail at Buitenzorg, flowering takes place between six in the morning and three in the afternoon, and it is at its maximum between 10 o'clock and midday. The flowers of the same panicle do not all open at the same time. It has been noticed that sometimes it takes 6 days, in some varieties even 10 days, for all the flowers of a panicle to open.

THE WEIGHT OF THE SEED.

The knowledge where the largest grains occur in an ear or panicle is important for the selection of seed grain.

In the case of rice, not very much is yet known on this point. According to Yokoi, a Japanese publication states that the best grains are found in the upper third of the panicle. This point has also been investigated and a number of determinations of the weights of the unhusked grains have been made, as well as of the grains themselves after husking. This last point was investigated in order to obtain if possible some idea of the quantity of reserves in the seed,—an important point as regards the development of the plants after germination.

For these experiments, a panicle is divided about the middle of its principal axis in such a way as to have an equal number of grains in the two halves. Then the grains are weighed before and after husking, and it is found that the upper half of the panicle gives a greater weight than the lower. Seventeen varieties have been examined in this way, and only three have proved exceptions to the general rule.

By dividing the panicles into three parts, the same result is obtained : that is to say, the upper part is generally the heaviest.

It has also been observed that the grains on the secondary axes are the heavier the nearer they are to the principal axis.

Another agreement between the panicle of rice and that of oats has been discovered in the matter of empty glumes. In rice, these occur in greater quantity towards the base of the panicle than in the upper part.

For the awned varieties of rice, it has been determined, that the awns of the grains in the upper half of the panicle are heavier than those in the lower half.

From the preceding facts, it will be clear that, almost without exception, the best grains for seed should be found in the upper parts of the panicle.

In this way a mechanical selection can be of use, and since this selection can be easily carried out and can immediately lead to an improvement of seeds, this question has been made another subject for investigation.

MECHANICAL SELECTION.

In several districts in Java, the natives are accustomed to place the grain which is destined for sowing in water : they discard the grains which float, and thus separate the empty (damaged) grains from the full ones. Sometimes they use a solution of ashes instead of pure water.

Several trials have been made by selecting first of all, in the field, the best panicles : the grains have then been selected according to their density by placing them in solutions of salt or sugar of different strengths.

These trials, however, are subject to several errors of experiment, and the results do not permit a conclusion to be drawn as far as regards the question whether, in a pure type, the grains which are specifically heavier are really heavier than the less dense grains ; and whether this difference is also manifested by the decorticated seeds.

These questions can only be solved if pure panicles (pedigree races) are available.

Van der Stok, who also investigated this point, prepared a solution the density of which was such that after two immersions of the grains, those not decorticated fell to the bottom. Afterwards, the grains were carefully washed, and dried in the sun, and their weights determined,

Experiments have been made with 44 pure types, and very divergent results have been obtained with regard to the relation between the absolute weight of the grains which sink and those which float. Sometimes the weights differ greatly, and give a result in favour of the grains which sink; sometimes the difference is small; and in three types, the advantage is even in favour of the grains which float.

If from the heaviest undecorticated fruits, some are selected and decorticated, it is then found that their greater weight can be due to their greater density as well as to their greater dimensions.

Investigations have also shown that the densest grains possess to a higher degree the faculty of ripening. Thus in selection by density different results will be obtained according as the seeds which are produced by a plant ripen more or less regularly, even if the seeds are derived from the same pure form (even from a pedigree strain).

In practice seeds fulfilling all these conditions will rarely be found, and in the majority of cases selection by density will give very irregular results.

Van der Stok insists on the fact that, having to deal with very mixed "populations," one risks, in a selection by density, obtaining a plant which exhibits a very different character from the plant of the preceding selection, without having any certainty that the change is an improvement.

Attempts have been made to ascertain the result of this comparative selection, by making trials in the field with the greatest possible accuracy and extremely careful control.

Four pure lines and three populations have been taken. The yield for one of the pure lines was worse when the denser grains were selected, for another, it was the same with grains of different densities, and for the other two the denser grains gave the better result.

One of the "populations" showed a small increase, the other two a decrease, from the heavier grains.

From these facts, the general application of this method is not advisable when one has to deal only with "populations."

As far as regards pure types, which can only be cultivated by following definite rules, the denser grains are generally superior. The advantage is small if one starts with a regular culture and with plants which all ripen at the same time, so that in the end the gain does not compensate for the trouble of carrying out this difficult method of selection.

It has been believed that certain dimensions of the fruit would bear some relation to its weight after decortication. With that view, apparatus has been devised which affords a means of separating the seed according to dimensions in order to improve it. Careful trials of grains selected by this means have not given any result.

It has also been thought important to search more closely for possible correlations between the length, breadth, thickness, and weight of the grains.

By separating the fruits, not decorticated, into three groups according to length, breadth, and thickness, it has been found that the thickest grains are usually the heaviest, and the same holds good with regard to length. These investigations were carried out with pure types (in the case of awned species, the awns are previously removed). In these the differences are not great enough to warrant the adoption of any selection based on them, even if it were practicable.

The experiments described were undertaken with the object of discovering some practical method of improving the seed.

HYBRIDISATION EXPERIMENTS.

The question of experiments in hybridisation which would permit of the development of a constant hybrid giving a higher yield has been dealt with.

Although these experiments have not met with much success, it has been possible, through them, to gain a better idea of the characters which are dominant in the rice plant. Some of the results will be referred to briefly here.

It has been determined that on crossing the variety *grandiglumis* Doll., which has very long superior glumes, with a variety with normal glumes, the type with short glumes is dominant.

Investigations on the faculty of producing a greater or smaller number of stems have been less satisfactory because of the great number of external factors which may influence the result. It has however been possible to determine that the phenomenon observed in other plants occurs also in rice, viz., that the first generation of hybrids exhibit a more vigorous growth and develop a greater number of stems.

Van der Stok, mentions also that on crossing an early with a late variety, early ripening generally prevails, but it can happen that the two characters equalise one another. Sometimes the character of late ripening prevails.

The scientific results must be applied to practice. To that end pure lines of different types of rice are cultivated, which will be investigated with respect to their yield and their suitability for native cultivation. It is evident that this necessitates a great number of trials in the field.

We have already seen that one must not remain content with selection only, but that seed farms must be instituted in order that the best use may be made of the results.

From efforts which have already been taken in this direction and which prove that the native cultivator is well able to appreciate the value of the better seed, it may be expected that those interested in the cultivation of rice will follow with the closest attention, and will derive very great benefits from, these seed farms. It may be asked, whether it is not sufficient to point out the way, and to prescribe methods by which the cultivators may arrive at an improvement of the rice plant, by using better seed, for example, and leaving to ordinary practice the task of applying the facts discovered.

The answer to that is that the application of methods for the improvement of grain demands in the first place a knowledge of the scientific principles on which the method is based, and therefore it is not a task which can be undertaken by anyone. And, secondly, as has already been proved in Europe, where the farmers in general have some knowledge of the principles of agriculture, the work of improvement of cereals demands so much attention and close control that it cannot be carried out in association with the ordinary work of cultivation.—Bulletin Economique de L'Indo Chine.

CANANGA OIL.

Business in this article has lately been very quiet indeed, although it has been possible to restore the prices to a reasonable level. The arrivals are not too heavy and the sales have moved within commensurate limits. We are, as always, in a position to supply our customers with the best quality at the lowest market prices.

Cananga oil is produced in two localities: it comes either from Serang or from Cheribon. Most of it comes from the first-named place; the Cheribon oil is not so well-known. Its quality is equally good as that of the oil from Serang, but its odour is somewhat sharper or to express it more accurately, somewhat more penetrating, a property which is preferred by some buyers, while others do not appreciate it so much. We only mention this because oils of this kind have lately repeatedly been seen in the market. We have not, however, met with any adulterated oil.—Report of Schimmel & Co.

FRUIT.

BANANA CULTIVATION.

(*Continued from page 462*).

Immediately the planting is done, in the drier districts or red soils (if not ready before) the mulch should be got ready in heaps, to apply whenever the land gets saturated with rain. In districts of good rainfall a green mulch of some suitable legume should be grown, not only to keep the surface covered, which will prevent wash on hillsides and to keep down weeds, but to provide a dry mulch later on in the dry months, which will give an addition of humus later, while a leguminous crop of course adds nitrogen. There are legumes that suit nearly all requirements. If it is only wanted to cover the ground for four months, Cow-peas are used ; if a thick covering for seven or eight months is wanted, Bengal Beans may be used one row up the centre, but growth is often too rampant, and they are apt to run over the bananas, causing some expense to keep them down ; and if the land is wanted to be kept covered as long as possible, Jerusalem Peas can be used ; no matter when these peas are planted they usually blossom about the end of October and they will keep green long after. They can be planted in two rows between the bananas, and while they cover the ground with a thick covering after four months growth they are not so rampant in growth or such climbers as the Bengal Beans. It is a good policy however, to cut them down when in blossom and leave the dry vines to cover the ground as a mulch through the dry spring months. Some growers let them go to seed first and cut them down. The seeds dropped grow again and give another crop. These peas also grow in medium shade, which Cow-peas refuse to do, and they will grow in heavy shade if they get light enough to start their growth when planted.

On stiff clay lands, the "Overlook Bean" is often used. It does not give such a thick dense close covering on the land as the legumes previously mentioned ; its growth is more open than these, but it sends down strong deep roots into the clay, thus opening up the subsoil and absorbing potash and phosphoric acid, unreachable by the banana roots, which later, through the stems and leaves, become manure for the bananas.

As has been mentioned, when two or more shoots spring from the suckers planted, the thickest and strongest should be left and the others cut out. Later on, when the first plant has grown about 4 or 5 feet high, (depending upon the climate) say 3 to 4 months after planting, more suckers will spring, and one of these, the best, may be left to follow the main plant, but if it is growing close against it, it should be cut and one better situated left. This, in banana planting language, is called a "follower." This is only allowed in the best land. In September there will be young shoots called "peepers" growing out around the first plant ; the stoutest of these can be left and all the others cut out. This will be the first ratoon sucker to fruit

in the spring 18 months later. On very rich soils two or three plants may be left to grow at once to fruit nearly at the same time, but they are slower to grow and the bunches take longer to fill than when one is allowed to get a good start first. As has been mentioned, the highest prices for bananas prevail between March and June; the aim is therefore to get most of the fruit in then, and so it is necessary to carefully time the growths, cutting out those young suckers that are too forward or are superfluous; to do this is called "pruning."

In each district almost each plantation has its own time to leave suckers for the next "spring" crop, depending upon the soil, climate and season. The first plants grown after planting are called "plant bananas" or "plants," any second plant allowed to grow from the planted suckers in the same year is called a "follower." The stems following these, off-shoots from them, are called "Ratoons."

The greatest desideratum in Jamaica is to get the bananas to bear their fruit as far as possible between March and June, as that is the period of greatest demand and highest prices. There is then no home grown fruit in the northern markets; the price of bananas however drops when the strawberries and cherries and peaches come in. In these months the price is usually 2/ to 2/6 per bunch at the ports; during other months it drops to 1/3 per bunch. These are seaside prices. Contracts are however made by the large growers and buyers with prices graded through the year from £5 up to £12.10 per 100 bunches.

The fruit of a banana is borne on a bunch, each fruit being called a finger and these are set in groups on the bunch called hands. In commerce however each collection of hands is called a stem, and is only a bunch and fetches full price when it has at least 9 hands. If it has 8 hands it counts three-quarters, if 7 hands a half, 6 hands a quarter. Each stem must have a minimum of 12 fingers on the bottom hand. The hands at the top of the bunch have usually more fingers, often as many as twenty, but commonly fifteen or sixteen. There are of course sometimes immense bunches of from ten, sixteen, even eighteen hands, which have fingers on each hand numbering sixteen to twenty or more. Planters do not aim at such fruit. The great bunches cannot be handled commercially. What the skilful grower aims at is a bunch of nine hands, no more and no less; he gets no more for ten or eleven hands, and he would rather grow two eights on one root, than one ten or eleven hand bunch.—Jamaica Agric. Soc. Journal.

CARDAMOM OIL.

The conditions of prices in the cardamom market have not yet improved and so far as our information goes, no improvement is to be expected within a foreseeable time. We have therefore been obliged to maintain our present quotations for cardamom oil. A parcel of so-called wild cardamoms has recently been offered from London, and, we hear, has been purchased by a firm in our branch of industry. To our certain knowledge, oil prepared from such cardamoms, although cheap, is in other respects wholly worthless, and its employment in the manufacture of comestibles may cost the users dear.—Report of Schimmel & Co.

TOBACCO.

THE EFFECT OF SHADING ON TOBACCO.

As is generally known, it is customary, in North America and Cuba, to grow tobacco under the shade of "cheese cloth" to obtain leaves of speciál quality. The actual effect of this shade on the transpiration, growth, etc., of the tobacco plant has been investigated by Hasselbring, in Cuba, and the following notes are taken from his account of his experiments, in the Botanical Gazette.

The "cheese cloth" employed in Cuba is a sort of coarse muslin with rectangular meshes of varying size, resembling in pattern the inner layer of the well-known waterproof wrapping paper. The meshes of the cloth used in these experiments averaged about one-eighth of an inch. In the middle of the day, when the sun's rays are nearly perpendicular, it casts a barely perceptible shadow, but the shadow is more noticeable early in the morning or late in the afternoon.

It was found that amount of light was greatly modified by the cheese cloth shade. The total amount of light under the cloth was only two-thirds that outside in the open. The diffused light under the cloth was, however, only slightly reduced. The plants under the cheese cloth, therefore, receive almost as much diffuse light as those outside, but a smaller quantity of total light.

The cheese cloth tent has very little effect on the temperature. On the whole, the temperature outside the tent is slightly higher than that inside. But the difference is very small, the average difference during an experiment which lasted 60 days being only about one-seventh of a degree Fahrenheit. This can have very little effect on the amount of moisture given off by the plants.

On the other hand, the humidity under the cheese cloth is higher than outside, except at night when the air is saturated both inside and outside the tent. During the day, the difference is increased because the moisture given off by the plants is prevented from escaping by the cheese cloth.

In addition to diminishing the illumination and increasing the relative humidity, the cheese cloth prevents or reduces air currents. All these changes tend to diminish transpiration, i.e., to lessen the amount of water given off by the plant.

The total dry weight of a tobacco plant grown under shade is the same as that of a plant grown in the open. The leaves of the shade-grown plants are larger, but they manufacture less plant food per unit area than those of plants grown in the open. And though the total (dry) weights of the plants are the same, the distribution of the weight is different. The shade-grown plants have a greater weight of stem and a smaller weight of leaf than those grown in the open. Shading increases the size of the leaf and reduces its (dry) weight.

T. P.

SOILS AND MANURES.

THIRD REPORT ON THE PARTIAL STERILISATION OF SOILS FOR GLASSHOUSE WORK.

E. J. RUSSELL, D.SC.

Partial sterilisation consists in treating the soil in such a way as to kill some, but not all, of the organisms present, and it is carried out either by heating the soil or by dosing it with mild poisons.

The effects of the treatment have been investigated at Rothamsted for some years past, and it has been shown to lead to (1) an increase in the production of ammonia and nitrate, (2) the destruction of many disease organisms and pests, and also of protozoa and organisms detrimental to bacteria, (3) the formation of certain substances not usually present in the soil, and (4) a physical improvement in heavy soils. The effect on the plant is therefore to give it a larger supply of nitrogenous food and a healthier medium in which to live; the unusual compounds also have certain effects on quality which, however, are not always very marked. The practical importance of the treatment is that it acts like a dressing of nitrogenous manure, and also enables the grower to deal with diseased or "sick" soils.

In attempting to apply partial sterilisation methods in practice there was the initial difficulty that the cost of the process was much more than any farmer could pay. The fertilising effect could be obtained more cheaply by the application of manure, and the difficulty of diseased soils, when it troubled the farmer at all, could be obviated by the simple expedient of growing some other crop not liable to be affected. In short, it was necessary both to cheapen the methods very considerably and to make them workable by labourers.

An elaborate series of plot experiments might have been planned for the purpose, but this would have been tedious and costly, and might have led to no useful result.

The plan was therefore adopted of finding growers to whom the question of soil diseases was of importance, and making experiments with their soils; the results were sufficiently promising to justify them in trying the method in their own houses. The growers soon improved and cheapened the methods considerably, and made them applicable to a wider circle than was possible before; important observations were also made which are dealt with in this report. The general result has been to confirm the earlier laboratory and pot experiments and to show that useful crop increases can be obtained by adopting partial sterilisation methods in a commercial nursery: there are some complicating factors and difficulties, but nothing that could not be overcome The method is now in use on a large scale, and the growers have gone further and set up an Experimental Station in their midst, where any further difficulties may be dealt with as they arise, and where their other problems can be investigated,

So far as the immediate object of improving the method is concerned the nursery experiments have been entirely successful. In the first Report issued (January 1912) the cost of steaming was given at 1*s.* 2*d.* to 1*s.* 6*d.* per ton of soil: a method is now at work which costs only 6*d.* to 9*d.* Although no chemical antiseptic has yet been found to act as well as steam, this side of the work has been pushed forward and definite advances have been made.

The methods available for partial sterilisation fall into two classes: (1) Treatment by chemical means; and (2) Various heating methods.

CHEMICAL METHODS.

Treatment by chemical means is much the more attractive because it allows of obvious extension from the nursery to the field, while heating apparently does not.

The method of treating the soil depends upon the nature of the antiseptic: a solid is simply mixed with the soil like horn or bone meal would be, but a liquid has to be watered in and the soil then turned to make the mixture as complete as possible. The usual proportion used has been one to two parts per 1,000 of soil, or 2 to 4 lb. per ton. As a dressing on the border this is equivalent to ½ to 1 lb. watered in per square yard. Experiments have been made to ascertain whether smaller quantities than these can safely be used, but it was found that they could not. The best results were always obtained by using the larger amount. The past season's experiments at Rothamsted were carried out in conjunction with Mr. W. Buddin, B.A., and were made with the same antiseptics as before, and, in consequence, the antiseptics can now be classified rather more accurately than was possible last year. The grouping arrived at is:—

Class I.—Most effective—Formaldehyde, Pyridine.

Class II.—Cresole, Carbolic acid, Calcium sulphide, Carbon disulphide, Toluol, Benzol, Petrol.

Class III.—Least effective—Naphthalene, etc.

The order of these classes is roughly the order of merit indicated by all the experiments, but considerable deviation occurred in individual trials.

Formaldehyde is distinctly promising, but it costs 5*d.* per lb., while carbolic acid can be obtained below 1½*d.* per lb. For the moment, therefore, carbolic acid has the advantage as an agent for commercial use.

Several chemicals have been used in large nurseries, including carbolic acid at the rate of about ½ to ¾ lb. per square yard (1 barrel of 20 gall. per house), and some of the more important proprietary articles. The use of these agents is perfectly feasible in practice, although attended with the difficulty that they are absorbed by the surface of the soil and therefore do not mix well, or wash down as freely as might be expected.

HEATING METHODS.

For the present none of the chemical agents is as effective as heat for nursery work, and most of the season's nursery trials were carried out on heated soil. Usually a house was selected that had given a bad crop in the previous year; the soil of the whole house was heated and the plants were

then set out. This is therefore a more ambitious affair than the mere heating of a little soil for pot experiments. The Lea Valley, where many of these trials were made, contains some of the most skilful growers in the trade, and is admirably adapted for the trials, since each grower introduces some modification in the method of working. No two men heated their soils in quite the same way : roughly speaking, however, the methods adopted fell into four groups :—1. Hot water ; 2. Baking ; 3. High-pressure steam ; 4. Low-pressure steam.

1. *Hot Water.*—This was run from the hot-water pipes on to the soil, until the top eight inches was saturated. Satisfactory results were obtained in some cases, but it is not clear exactly what the effect was, because flooding with cold water has also been found to be beneficial in some cases. These results will therefore not be discussed at present.

2. *Baking.*—Baking seems to be far the best method for the small grower. Mr. Holmes of Tuckswood Farm, Norwich, has shown considerable ingenuity in devising suitable forms of apparatus in which the heat is utilised as fully as possible, so that only a minimum amount of fuel is necessary. Mr. Holmes states that baking can be done at $5\frac{1}{2}d.$ per ton of soil when it is worked in properly with the other operations going on in the nursery. One large grower who baked a considerable amount of soil found the cost of fuel to be about $2\frac{3}{4}d.$ to $3d.$ per load treated, and of labour approximately $5d.$ a load : the total cost therefore is about $8d.$ a load.

Most of the large growers, however, prefer steaming; some use high pressure, others low pressure steam.

3. *High-pressure Steam.*—Two methods of applying high-pressure steam were tried. In one a box was made, without top or bottom, about 6 to 9 ft. by 3 ft. and some 18 in. deep. This was placed on a grid formed of iron pipes $1\frac{1}{2}$ to 2 in. diameter, perforated with $\frac{1}{8}$ in. holes and connected with the boiler. Soil was then put into the box and covered with sacks ; steam was blown in at a pressure of 40-80 lb. for 20 minutes, and the soil was then thrown into a heap. This method was used for soils wanted for cucumber borders and for tomatoes in pots.

The other method, used in tomato houses, consisted in steaming the soil *in situ* and did not involve taking the soil out. It is a combination of trenching and steaming. The trenching is done in the usual way : a section, 9 in. deep, 2 ft. 6 in. across, and 9 ft. long, is excavated and the soil removed ; a grid is laid at the bottom ; then soil from the next adjoining section is thrown in and packed up level, leaving a new trench of the same dimensions ; steam is then blown through for 15-20 minutes. The grid is then pulled forward by means of hooks or short chains into the new trench, and soil is thrown on as before, leaving a new trench into which the grid can be drawn after the steaming is done. One gang of men can keep two grids going side by side, and the work can be so organised that neither boiler nor men have to be kept waiting, i.e., the grid has to be pulled forward and covered up and the trench

prepared in 15-20 minutes, the steam meanwhile being blown through the other grid. The work is sometimes rather trying because a good deal of steam escapes into the house.

The past season's experience suggests that 1 in. to 1½ in. piping is big enough for the main and ¾ in. to 1 in. big enough for the grids : these dimensions are a little less than those given earlier. The holes may be ⅛ in. in diameter, 6 in. apart at the sides and 1 ft. at the top. The ordinary form of grid has to be lifted bodily out of the soil, which is rather heavy work, but MR. V. G. MINARD'S comb-shaped grid (described fully in "THE FRUIT GROWER, FRUITERER, etc.," Jan. 30th and Feb 6th, 1913), which is 9 ft. by 2 ft. 6 in. with 13 prongs of ¾ in. pipe, bored with holes 6 in. apart obviates this difficulty entirely, and need only be drawn out. A blowpipe arrangement of steam and water jet is used by MR. MINARD for getting round piers and pipes. In the previous report a harrow-like apparatus was described for use in steaming the soil, but it is now believed that this is inferior to the grid. It is not yet clear to what depth the steaming should be carried out, but a usual depth has been the top nine inches ; greater depths have been tried, but there was nothing to show that the results justified the expense. On the other hand, good results have been obtained when only the top six inches was heated. No general rule can be given as to the time required for steaming, but every part of the soil must be heated above 200° F.; it is therefore desirable to take the temperature. Less than 15 minutes' steaming is not usually sufficient, and unsatisfactory results have followed steaming for shorter periods.

In an earlier report it was pointed out that dry soil required less steam to raise it to 210° F. than moist soil ; experience in the nurseries, however, has shown that some degree of moistness is necessary, otherwise the soil does not heat well on account of its low conductivity. The mean has therefore to be discovered by making a few trials at the beginning to find when the soil is sufficiently moist for proper working.

4. *Low-pressure Steam.*—This is used with the box and grid for cucumber soil exactly like high-pressure steam. The grid is covered with loose boards, through the chinks of which the steam issues ; by thus keeping the soil off the grid the steaming becomes more efficient and the soil is left drier than when it lies direct on the grid. Steam at 20 lb. pressure is blown through for 30 minutes : a box larger than usual is adopted, suitable dimensions being 12 ft. by 3 ft. 6 in. and 18 in. deep.

Another method used by MR. HOLMES has the advantage of not requiring the soil to be moved out of the house. The soil is first forked over, and on it is inverted a tray made of metal, e. g. galvanised iron, backed by boards ; the steam is then blown underneath and finds its way into the soil, raising the temperature to a depth of 10 in. or more. If the trays are left after the steaming is discontinued the temperature only falls slowly ; after 18 hours it

was found to be still 120° F. at a depth of eight inches below the surface. There should be very little escape of steam into the house, and to ensure this the trays are carefully banked with earth.

The trays are six feet wide, this width being chosen so that they can fit easily between the piers and pipes, which are commonly seven feet apart. The best length is not yet determined, but is probably six feet, as the trays are then square and not too heavy to be handled by two men. Iron piping of $1\frac{1}{4}$ in. diameter is used for the steam main, and plugs are introduced at intervals to allow the insertion of lateral delivery pipes; these terminate in a **T** so that the steam shall not blow out with too much force. The time necessary for steaming naturally depends on the area of soil and the volume of steam, so that trials have to be made at the outset by inserting a thermometer to a depth of 8 in. In one nursery one hour's steaming sufficed; fifteen minutes were only given in another; while in a third a number of trays were laid end on end and steam was run for some hours; the trays were then left as long as possible (e.g. overnight) so that the cooking might continue. In this case the movement of the steam is facilitated by digging a channel in the soil the whole length of the trays. Only low-pressure steam is needed and no forced draught is required.

The great advantage of this method is the reduction in the cost of labour, hitherto the most expensive item in heating. There is also less waste of steam in the house. Its efficiency has yet to be established, but the method appears to be good.

COST.

All the systems described have their advocates, their advantages and their disadvantages, but the great determining factor must necessarily be the cost. The present methods of growing require that cucumber borders must be cleared out from the houses, and hence some outside arrangement for heating is necessary; tomato and other soils, however, need not be removed, and therefore they must be steamed *in situ*. The following are some of the figures as to cost that were actually obtained in nurseries in the past season :—

Outside Methods, used for Cucumber Borders.

Method.	Cost of Labour.	Cost of Fuel.	Total.
Baking ...	5*d.*	$2\frac{3}{4}d.$	$7\frac{3}{4}d.$ per ton
Steaming ...	9*d.**	[illegible]	[illegible] per ton

* Higher because the soil had to be wheeled out to the steriliser and then back again.

Inside Methods, used for Tomato Houses.

Method.	Cost of Labour.	Cost of Fuel.	Total.
Grid ...	1½*d.*	1½*d.*†	3*d.*‡ per sq. yd.
Tray Method			
Nursery A ...	½*d.*	1*d.*	1½*d.* ,, ,,
,, B ...	2*d.*‡	1¾*d.*	3¾*d.*† ,, ,,

Nothing has been allowed for depreciation of apparatus, interest on outlay, etc., because of the difficulty of knowing how long the outfit will last and what other use can be made of the boiler. When an allowance satisfactory to the grower is added the total cost comes to 1*s.* 3*d.* to 1*s.* 6*d.* per ton for cucumber soil and £8 to £10 per house for tomato soil by the grid method, or £3 to £5 by the tray method, the house being usually ⅛ to ⅐ acre in extent, often 25 to 28 feet wide, and about 200 feet long. It must be remembered, however, that part of the labour is necessary to the growing and would be required in any case ; the figures, therefore, are on the high side.—

Journal of the Bd. of Agric.

(*To be Continued.*)

RESULTS OBTAINED WITH VARIOUS GREEN MANURES.

W. M. VAN HELTEN.

The plants with which experiments were made at Tijkeumeuh (Buitenzorg) were divided into four groups according to the most suitable manner of utilizing each kind.

I. Green manure plants sown between the rows of the main crop and the leaves of which may be cut regularly.

Plant.	Qualities.	Defects.
Tephrosia candida	Lives long, leaves abundant, decomposition slow*	—
Clitoria cajanifolia	Do.	—
Leucæna glauca	Lives very long, abundant production of seed, stands slight shade	Very rapid decomposition
Tephrosia hookeriana var. *amœna*	Adapts itself to poor soils	—
Desmodium gyroides	Lives long	Numerous buds fail to grow.
Indigofera anil	Lives long, leaves fairly abundant, large production of seed.	Rapid decomposition.

†Later experience showed that a lower pressure steam would have sufficed than was actually used (120 lb.), and that an economy in fuel could have been effected.

‡A re-arrangement of work was afterwards made whereby the labour was reduced by one-third, and the total cost of the last sections was therefore 3*d.* per square yard.

* The slowness of decomposition allows a plant to be used as mulch.

II. Green manure plants which may be worked in before planting the main crop, or which may be used as I. but yielding only one cut.

Plant.	Qualities.	Defects.
Phaseolus calcaratus	Covers the soil rapidly, leaves abundant	Lives only one year.
Pueraria phaseoloides	Do.	Attacked by flea beetles.
Crotalaria incana	—	Attacked by several insects, become bushy
,, *striata*	—	
,, *laburnifolia*	Leaves abundant	The stalk becomes woody
,, *quinquefolia*	Rapid growth, gives in a short time a large quantity of leaves, does not become woody	Destroyed by insects
,, *alata*	Covers the soil rapidly, do not become woody; *ferruginea* has a special abundance of leaves	Destroyed by insects
,, *ferruginea*		
,, *juncea*	Rapid growth on good soil	Must be thickly sown, lives only 6 months
Vigna sinensis	Grows rapidly, leaves abundant	—
Cassia mimosoides	Rapid growth, great quantity of seed	Must be thickly sown, lives only 6 months
,, *patellaria*	Do.	—
Canavalia ensiformis	Adapts itself to very bad soils	—

III. Climbing green manure plants which can be used as I.

Plants.	Qualities.	Defects.
Centrosæma plumieri	Luxurious growth, throws out roots at every node, does not climb much, yields much seed, even on the ground, can live three years.	Climbs a little, so the main crops must be disengaged every six weeks.

IV. Climbing green manure plants which can be used only by working them in before planting the main crop.

Plants.	Qualities.	Defects.
Mucuna sp. with violet flowers and white seeds	Luxurious growth	Attacked by disease and dies in 9 months.
Phaseolus lunatus	Lives two years	—

The writer gives the following data on *Tephrosia* :

	Yield of green leaves per acre.	Quantity of seed required per acre.
T. candida	8,480 lb.	112 lb.
T. hookeriana	7,580 ,,	121 ,,
T. vogelii	8,030 ,,	136 ,,

—Monthly Bulletin

CATTLE MANURE.

H. C. SAMPSON.

What is cattle manure? The answer to this question depends very much on the quality of the farming. The best cattle manure consists of the solid and liquid excreta of cattle mixed with sufficient litter to absorb the liquid from the excreta which have been allowed to slowly rot or decay. The dung of cattle contains the undigested food which has been given to the animals and which has been finely divided both by mastication and by the action of the gastric juices in the stomach of the animal. Much, of course, of what would be valuable as manure has been absorbed by the animal into its system to help it to build up new or replace worn out tissue; but in feeding animals, that is, if they are kept in good condition, it is always necessary to give the animals more food than this actual quantity, and it is this excess which adds to the manurial value of the manure. Thus it is that manure from well fed animals is always of more value than that obtained from animals which are half starved. The urine of animals is of very considerable value as a manure. The urine contains all the waste tissue from the body. This product is of very great value as a manure as it supplies in fairly large quantities the most valuable of all food requirements. The litter used may be merely an absorbent such as dry earth or it may be waste fodder which the cattle do not eat, in which case it not only absorbs liquid but supplies a quantity of vegetable

matter which, when it decays, has the power of holding moisture. Thus when applied to the land it assists in preventing the soil from becoming dry. Or again the litter may be vegetable material such as dried weeds, dried leaves, or any other similar substance which is no use as a food for cattle.

We can now to some extent understand why cattle manure is of such value. It supplies plant food, it assists the soil in retaining moisture, and further, as the decayed vegetable matter becomes a part of the soil itself the texture of the soil greatly improves, that is to say, the soil easily crumbles when it becomes moist and does not cake into such hard lumps when it is dry. In the black cotton soils of the south, where it is the practice to manure heavily for the cumbu crop, the soil on such lands is much softer under foot and much more freely broken than is the case with similar soils which are never manured. It is often possible in the case of garden lands to tell by the feel of the soil whether the supply of cattle manure has been ample or not.

Now this improvement in the texture of the soil is of immense value. Every farmer knows that land which has become exhausted by over cropping or by growing the same crop year after year will to a great extent recover from this exhaustion if left fallow. What is the reason of this? This means that the plant food has been there all the time but it was not in such a form that the next crop could make use of it. The exposing of the land to the action of the wind, rain and the sun's heat has had the effect of making this food in the soil of use to the next crop. Now even if cattle manure contained no plant food it would have the effect of opening up such a soil. This would allow the plants' roots to go easily in all directions in search of food. The plant would then be in a position to make the best use of this and thus give a better crop. A very good example of the value of opening up the soil is to be seen in the use of coal ashes in South Arcot. Coal ashes are of practically no value as a manure, i.e., they contain practically no plant food. Yet ryots of South Arcot will often pay as much as Rs. 3 a bandy load simply because these ashes improve the texture of the soil.

In wet lands also cattle manure is of great value not only as a supplier of plant food but on account of the way in which it improves the physical condition of the soil. The decayed vegetable matter in the case of light soils with very free drainage enables the land to retain moisture. At the same time it improves the texture of heavy soils and allows of a movement of water in the soil, i.e., it prevents the water from stagnating.

Having now seen in what way cattle manure is useful, the next thing to learn is how to prepare the best cattle manure by means which are within the reach of every farmer. The best methods which are employed by the farmers of the Madras Presidency will be described. There is no doubt whatever that the Tulu farmers of South Canara district make much better cattle manure than is made anywhere else in the Presidency, and any one who compares their paddy crops with those of the Malayalam country will at once see that it pays them to do so. The cattle sheds are constructed with the ordinary materials at hand but the floor of the shed is sunk into the ground to a depth of two or more feet. The cattle if valuable are kept tied up or if of not much value are simply let loose in the shed. Where jungle leaves are plentiful, these are daily collected and scattered on the floor of

the shed to cover the droppings made by animals in the previous day. These green leaves form bedding for the cattle for the next day, when the same method is again adopted and this continues until the sunk floor is raised up to ground level. Where jungle is scarce, the people send out children or old women to collect leaves which fall down from trees, and it is quite a common sight to see near the cattle shed a stack of dried leaves which are used as required, for bedding. By this means all the dung and all the urine besides a very considerable amount of vegetable matter go to make the manure. The feet of the cattle tread this down and make it sufficiently compost to check too rapid decay. When the shed is full the manure is removed usually to a corner of the field where it will be required, neatly stacked and covered with soil.

In part of North Arcot district the following method has been described by which the urine is collected. The droppings of cattle are collected from the floor, dred in the sun and beaten to a fine powder. This is spread on the floor of the cattle shed as bedding and its use is to soak up the urine voided by the cattle. Next day this bedding is removed to the manure pit and fresh bedding is made from the fresh droppings of the cattle. Another method which has been tried and found useful, especially in places where litter is scarce, is to provide dry sandy earth as bedding. A layer of about three inches deep is spread on the floor and each morning after the dung has been removed this is raked over so that fresh dry soil is placed where the urine is usually voided. After a fortnight or so this dry earth, which has soaked up most of the urine, is removed and spread over the dung heap. This method could well be adopted in dry districts. In Coimbatore and in Tinnevelly where ryots dig pits in which they store their cattle manure and which they periodically cover with tank silt, this dry earth method impregnated with urine might easily be substituted, as at present no attempt is made to conserve the urine which should form a valuable adjunct to the manurial value of the cattle dung.—Madras Agricultural Calendar.

ERADICATION OF WEEDS.

Experiments on the destruction of weeds by spraying, conducted by the Department of Agriculture, Surinam, have not yielded very favourable results. The mixture employed was an arsenical preparation consisting of 1 kilogramme white arsenic, 4 kilogrammes Soda, and 160 litres of water. The arsenic and soda were first boiled together in ten litres of water until quite dissolved, and the mixture made up to 160 litres. Spraying was carried out at the beginning of the dry season. All the weeds were killed, but by degrees, new growth appeared, especially of "Para grass." The more tender plants were evidently quickly destroyed, but the stronger were only partly injured, so that these afterwards overgrew everything else. Hevea and Plantains were not injured. Experiments to clear the ground completely of weeds were unsuccessful: the worst weed, *Cyperus rotundus* (Kora.—Ed) always reappeared, as its tuberous rootstock was not killed.

ENTOMOLOGY.

LEAF MINER OF CITRUS (*PHYLLOCNISTIS CITRELLA* STAINTON).

The caterpillar of this Tincid moth mines underneath the upper or the lower epidermis of the young leaves, thus causing them to curl up.

The mines occur also underneath the epidermis of the young twigs. The mine often begins near the midrib, runs towards the base of the leaf where it takes one or two turns, runs alongside the margin and takes one or two turns and then approaches close to where it began.

The course of the mine is marked out by a narrow band of brownish frass and the mine itself has a silvery appearance. The bands of frass frequently trace out curves that resemble a stocking foot. Not infrequently four or five caterpillars may be present in a single leaf.

The caterpillar is very small being about 2·50 mm. in length. It is green, flat, distinctly segmented and has a comparatively large, triangular head with a projection in front of the antennæ. The antenna terminates in two, finger-shaped, blunt processes the outer one of which is the larger.

The mouth parts are complex. They consist of a pair of sharply-pointed teeth, a pair of sickle-shaped, chitinous processes with serrated, cephalic margin and a membranous hood; the sickle-shaped processes cross each other when in action. There are no legs nor prolegs.

The pupa of the moth is formed below a close web of white silk under the folded margin of the leaf. It is yellowish-brown in colour and almost 2 mm. long. The posterior end bears dorsally two, sharp, cone-shaped processes. The anterior end is provided with a comparatively long, sharp heavily chitinised, sickle-shaped process whose function doubtless is that of rupturing the cocoon. The black eyes are often distinct when the venter of the pupa is in view. The abdominal segments bear on the dorsum stout, sharp, backwardly directed spines, while there is a row of long hairs on the sides of the abdomen. The antennal sheath reaches almost, sometimes quite, to the apex of the abdomen.

The moth has a silvery appearance. The apex of the forewing is yellowish and bears a broad fringe. There are several rows of black-tipped scales in the fringe and these black tips form distinct transverse bands. At the apex of the wing is a distinct black spot.

(I have reared a very similar moth from the leaves of *Melia azedarach*. The pupa, however, shows points of difference. The cephalic process here is not sickle-shaped but triangular, and its base is serrated laterally on each side).

The caterpillars are subject to the attack of small, black chalcids, the larvæ of which feed externally on the caterpillar. While these parasites no doubt do a great deal of good they do not seem able to keep the moth from being injurious. Were the attack noticed early enough a spraying with tobacco extract might do some good. The attack, however, has usually passed before the casual observer's attention is drawn to it. The citrus grower should make himself acquainted with the first symptoms and be on the outlook for them.

On occasion the folded leaves are subsequently tenanted by mealy-bug, *Pseudococcus sp.*, and they continue the injury. Pseudococci, however, are less injurious in Ceylon than they are in many other countries. Here they are attacked by various enemies the two chief being the caterpillar of the *Lycænid, Spalgis epius*, West. and a Cecidomyiid (*Diadiplosis coccidivora*, Felt).

The larvæ of the Cecidomyiid are orange coloured maggots while the caterpillar of the Lycaenid is covered with white wax and is not easily distinguished among the mealy bugs; it has a small, black head and the anal end is heavily chitinised while the body is thickly covered with stout hairs. There are four pairs of abdominal prolegs and a pair of anal prolegs. The hooks of the prolegs are in two series in a longitudinal, curved band on the inner side and there are also a few isolated hooks on the outer side. The thoracic legs taper somewhat rapidly to the tip.

Other insects that have been observed or recorded recently as doing more or less damage to citrus trees in Ceylon are :—

Walkeriana sp. This large Coccid encrusts the stem and branches. It is heavily parasitised by an Agromyzid, *Cryptochætum curtipenne*, Knab., the maggot of which lives internally in the Coccid forming its pupa rium there. The scale is attended by a species of *Cremastogaster*, but the ants do not succeed in deterring the *Cryptochætum*.

I have observed a colony of Walkeriana that was practically wiped out by the caterpillar of a Pyralid. The caterpillars fed on the scales under the shelter of a web of dirty white silk. Many of the scales had been killed by the Agromyzid, but I think that healthy scales are also subject to attack.

Coccus viridis, Green. (Green Bug)

Lepidosaphes beckii, Newm. This Coccid infests the fruit and leaves causing the latter to crumple.

Toxoptera sp. This Aphid is occasionally found on the young shoots but does not become numerous enough to do much damage.

Tetranychus mytilaspidis, Riley. A mitè that closely resembles this mite occurs on the leaves causing them to turn yellow.

Apogonia comosa, Kav. This melolonthid beetle has been reported as eating the leaves.

Occasionally, from fruit that has fallen prematurely, small bright-eyed flies emerge. These are Drosophilids whose habit it is to lay their eggs in fermenting material. The fruit has fallen from some cause or other and the flies probably infested it as it lay on the ground.

A. RUTHERFORD.

"SLUG CATERPILLARS" OR "NETTLE GRUBS" OF TEA.

The Caterpillars of Limacodid moths are popularly known as "Slug Caterpillars" or "Nettle Grubs." The former name has reference to the fact that they move with a gliding motion like slugs, the latter to the fact that many of them bear spines with nettling properties. It is commonly supposed that the glands secreting the urticating liquid are situated at the bases of the spines and that when a piece of the brittle spine is broken off in the skin some of the fluid gains access to the skin and sets up an irritation.

The larvæ feed in exposed situations. Those that have spines with urticating properties are very brightly coloured, while those without such spines are inconspicuously coloured; the former are warningly, the latter protectively, coloured.

The cocoons are dense and the moth escapes by a circular lid at one end. Several species feed in the larval stage on tea and at times do a considerable amount of damage. Their appearance ought to be familiar to everyone in charge of a tea plantation and their potential powers of destruction realised. An attack usually begins in a small way and gradually increases in intensity; and if the earliest caterpillars are systematically collected and destroyed much work and expense will be avoided. They should be collected by means of forceps or the collectors should wear some stout covering on their hands.

In the case of a bad attack spraying the plants attacked with an arsenical poison may be resorted to. Paris Green and lead arsenate are the two best known arsenicals, and of these lead arsenate is to be preferred, as Paris Green is liable to 'burn' the foliage owing to its containing more or less of the soluble arsenious oxide. When Paris Green is used as a dry application it should be mixed with six or seven times its own weight of freshly slaked lime. Lead Arsenate is usually used as a spray at the rate of 4 lb. to 100 gallons of water.

As arsenicals are poisonous there is naturally a prejudice against their use. In the United States of America, however, Paris Green and arsenate of lead are largely used. Indeed it would be almost impossible to grow cotton, apples, peaches, tobacco and vegetables without them.

With regard to the danger from the use of arsenicals Mr. Morlatt in Farmers' Bulletin No. 127 says:—

"The poison disappears from the plants almost completely within 20 to 25 days, and even if plants were consumed shortly after the application an impossible quantity would have to be eaten to get a poisonous dose. To illustrate, in the case of the apple, if the entire fruit were eaten, core and all, it would take several barrels at a single sitting to make a poisonous dose (Riley) and with the cabbage dusted as recommended above (1 ounce Paris Green to 10 lb. of lime) 28 heads would have to be eaten at one meal to reach this result."

In the case of tea it does not seem to the writer that any real danger from the application of arsenicals need be apprehended. If the poison were applied after a round of plucking and the next pluckings rejected, the foliage that would have unfolded by the succeeding plucking would practically be free from poison. In order to avoid even the appearance of danger, pluckings from the sprayed area might be rejected until there had come forward a new growth, that had been in the bud stage at the time of spraying. Any loss would be amply repaid by the freedom of subsequent crops from the depredations of caterpillars.

For those who do not care to resort to the use of arsenicals the only practice that can be recommended is to thoroughly prune the infested area, burning all prunings and any refuse lying on the ground. The pruned bushes should thereafter be carefully searched for cocoons and the surrounding bushes for stray larvæ.

Whether by collecting, spraying, or pruning and burning an endeavour should be made to prevent the emergence of a fresh brood of moths.

Arsenate of Lead can be obtained from Messrs. D. Waldie & Co., Konnegar, Calcutta at Re. 1/- per lb. and from Messrs. Heatley & Gresham Ltd., Calcutta in 20 lb. kegs at—6/6 per lb., in 50 lb. kegs at—5/9 per lb.

THOSEA RECTA, HAMP. "MORAWAK KORALE NETTLE-GRUB."

This nettle grub has been recorded from Ambegamuwa, Balangoda, Dolosbage, Morawak Korale, Badulla, Nawalapitiya, Yatiyantota, Dehiowita, (on Albizzia), Galaha, Deniyaya, Nilambe.

The caterpillar is about $\frac{1}{2}$ inch long. Small thoracic legs are present and can be seen with the aid of a pocket lens.

The colour is variable. The ground colour is bright orange or green and there are three, bright crimson, purplish or brownish areas on the dorsum, the most anterior of which is narrow and slightly constricted at two points, the middle one broad and diamond-shaped with a lateral expansion on each side, and the posterior one of intermediate width and more or less deeply constricted.

These dorsal areas sometimes bear shining white spots, one at the caudal end of the most anterior, one near the cephalic end and one on each lateral expansion of the middle, and two, one behind the other, on the posterior dorsal area. There are two rows of spiny tubercles on each side, one just outside the dorsal areas and the other low down on the side.

The cocoon is attached to leaves or twigs. It is about 3/10 of an inch long, oval, dark-brown with lighter patches. The adult escapes by a circular lid at one end. The pupal skin protrudes and may even come to lie outside the ruptured cocoon. Between the eyes of the pupa is a sharp, transverse, slightly pointed, chitinous ridge. This may be used to cut the lid in the cocoon, though Hampson states that the lid for the escape of the imago of Limacodidæ is prepared by the larva.

In *Euclea indetermina*, Boisd., a Limacodid of America, there is said to be a prominent, hornlike process extending above and between the eyes.

The imago issues from the cocoon in about 20 days. It will be recognised from the following description which is that of a male :—

Head, abdomen and thorax brown. Triangular brown patch with a bronzy sheen at base of wing; sharply defined outwardly by a pinkish-white, transverse, slightly oblique band. Similarly coloured area caudad of costa except at base and apex, and another at anal angle of wing. The rest of the wing is of a pinkish-white colour.

THOSEA CANA, WLK, THE "GREEN NETTLE GRUB."

Green states that the caterpillar of this moth is practically indistinguishable from that of *T. recta*. It has been recorded from Kelani Valley, Elpitiya, Avisawella, Galaha, Deniyaya.

In India it feeds on castor.

THOSEA CERVINA. MOORE.

Thosea cervina, which is stated by Watt and Mann to be a pest of tea in Assam, has been found feeding on *Piper nigrum* at Bandarawela.

Watt and Mann state that the cocoons of this moth are to be found at a depth of 1 to 1½ inches below the surface of the ground.

NATADA NARARIA. FRINGED NETTLE GRUB.

This is probably the most destructive of the nettle-grubs of tea in Ceylon.

A correspondent recently wrote, "About 80 acres are covered with them and the leaves are dropping off the bushes. . . . They are getting at the young stuff as well as the old."

Leaves that have been attacked are eaten in patches through to the upper epidermis, and the epidermis that is left bears a pattern of curving lines and is covered with an iridescent substance that gives a sticky appearance to the leaves. The margins of old wounds are surrounded by a dark coloured ridge.

The eggs are not conspicuous. They are flat, oval and transparent and are deposited singly on the upper surface of the leaf.

The caterpillar is about ½ in. long. Thoracic legs are not absent as stated by Green (Circ. R.B.G. Series I No. 19). They are reduced but can be seen with the aid of a pocket lens. The head and prothorax are retractile.

Along the median dorsal region is a broad, purplish band bounded by an orange coloured band. The purplish band is contracted twice and on the margin of each expanded portion is a crimson spot. Laterad of the orange band the colour is bright green. Along the edge of the orange band are nine tubercles bearing small, dark-tipped spines. On each side dorso-laterally are eleven long, pointed tubercles bearing spines. The members of the terminal pair are somewhat separated from the rest and project caudally.

The third in order from the cephalic end is suffused with purple and there is also a purplish area caudad of the four most anterior tubercles and the spines of these tubercles are purplish in colour. Younger larvæ have the purple dorsal band less well marked and nearly full grown ones may be without the stripe altogether.

Many of the larvæ perish from a disease. They become brownish in colour, somewhat glossy and turgid. They retain their shape for a time but the tissues have broken down into a brownish slime.

The larvæ are attacked by a parasitic Hymenopteron, an Ichneumonid with clouded wings. The correspondent referred to above stated that "a sort of a cross between a fly and a wasp is buzzing about the affected parts." This may well refer to such a parasite, though but one Ichneumonid was obtained from the material sent.

The cocoon is dark brown in colour, about 1/6 inch broad and 1/5 inch long, and is covered with a thin web of brown hairs. It is attached to the leaves or twigs of the plant or to fallen leaves and rubbish below the tea. There is a sharp, transverse, strongly chitinised ridge of chitin between the eyes of the pupa. The moth may emerge in 17 days. Sometimes the empty pupa case lies free from the cocoon, sometimes it is quite enclosed, and there are all gradations between these two conditions.

Male. Forewing whitish at base, reddish-brown, with a central black dot in middle area. The reddish-brown area is bounded outwardly by a black line backed by a much more distinct whitish band. The fringe and edge of the wing is brown. Antennæ are bipectinate. Expanse 12-20 m.m.

Female. The female is larger (22 m. m.) and the antennæ are simple. Forewing reddish-brown except for a broad band of paler brown towards the apex. At the junction of these two areas is a black band. Black scales are scattered all over the wing. The insects on emergence in confinement have a habit of clinging in an upright position to the side of the cocoon.

The moths vary in colour. One lot was much darker than those described above. In the female the band separating the darker basal area and the lighter apical areas is Y-shaped and in the basal area is a black spot. The only difference noted in the larva as compared with the larva described above was that the band bordering the purple band was pinkish and not orange.

Natada nararia has been recorded from Passara, Gonakelle, Rangalla, Badulla, Demodera, Haputale, Numunukula, Dolosbage, Aranayake, Elkaduwa, Rattota, Wattegama.

Different species of Limacodidæ seem to be socially inclined.

Among a colony of *Natada nararia* were two larvæ of a different species. They are reddish-brown in colour, except the lateral margins of the last four segments which are orange yellow in colour. There are hair-bearing tubercles on the dorsum and along the lateral margin but the hairs are short and of the same colour as the body.

The two posterior processes are conspicuous and divergent. On the second abdominal segment is a median, dorsal, hairless tubercle.

The younger specimen has a conspicuous white spot just mesad of the orange coloured band on the antepenultimate segment.

Unfortunately both larvae perished.

On the upper surface of the same leaves as were providing food for the *Natada nararia* was a small (about 4 m.m.,) oval, greyish-white cocoon of a Limacodid.

The moth that emerged from this has its wings blackish towards the apex, near which there is a distinct sooty-coloured area.

The fringe of the front wing is dark, that of the hind wing whitish.

The pupa bears a strongly chitinised, sharp, transverse ridge between the eyes.

PARASA LEPIDA. CRAM. BLUE-STRIPED NETTLE GRUB.

This caterpillar has been reported from Ratnapura, Peradeniya, Wattegama and Marawila.

It feeds on Cacao, Coconut, Plantain and Coffee as well as on Tea. Lefroy states that it feeds on Castor and Mango in India, has been recorded as abundant on Asphal (*Nephelium longana*) and has been reared on Country Almond (*Terminalia catappa*).

The eggs are oval, flat and overlap each other.

The caterpillar is about $\frac{3}{4}$ inch long when full grown. The general colour is greenish-yellow with three broad, pale-blue longitudinal stripes each edged with blue-black, one mid-dorsal and the others lateral. Between the mid-dorsal and lateral stripes on each side is a row of tubercles bearing spines in tufts. Another row runs ventrad of each lateral stripe. The spines are green with black tips. Several of the spines on two pairs of dorsal thoracic tufts and also on a pair of tufts near the anal end are modified into stout, brownish, cylindrical processes. Arranged round the posterior end are four large tufts of short black hairs. On the dorsum of the prothorax are two small, black plates of chitin, straight on their mesal margins.

Green records hymenopterous parasites of the genus Apanteles as having been reared from caterpillars. Apanteles sp. are internal parasites. When full-fed it is their habit to issue from the host and spin, often in immediate proximity to the host, white cocoons. These have been mistaken by persons ignorant of their true nature for eggs of the larva and destroyed.

The cocoon is hemispherical and dark brown and is usually placed on the tea stems. The pupa is provided with a sharp, transverse ridge between the eyes. The moths emerge in from 4 to 5 weeks.

Hampson characterises the moth as follows:—

Male. Head green, red-brown at the sides; thorax green with a brown stripe on the vertex; abdomen brown; forewing pea green; a red-brown basal patch on the costa (front edge of wing); outer area red-brown, widest at inner margin. Hind wing yellowish at base, red-brown towards outer margin. Legs with joints pale tipped. Expanse 30 m. m.

Female. The red-brown stripe on the thorax wider and nearly the whole of the hind wing red-brown. Expanse 42-50 m. m.

TERMITES.

The Editor, "Tropical Agriculturist."

Sir,

I have read, with interest, Mr. Rutherford's Entomological Notes in the April number of this Journal.

With regard to his proposed measures against the Tea Termite which, from the symptoms described, must be either *Calotermes militaris* or

C. greeni, I am afraid that any attempt to find and destroy the nests will be doomed to failure. For, as I have shown in my note on *Calotermes militaris* (T.A., March 1907, p 181), this species does not make any nests comparable with those constructed by many species of *Termes*. The same holds good for *C. greeni*. There is no specialized queen, and no true worker caste. The apparent workers are all immature males and females. The adult females may be either winged or apterous. Many of the latter form occur in every colony and may be distinguished by their darker colour and firmer integument. The eggs, instead of being elaborated in enormous numbers by a single queen, are produced in comparatively small numbers by these small unspecialized females which are responsible for the increase of that particular colony, reproduction taking place within the galleries of the infested stems where individuals in all stages of growth may be observed. Winged individuals are apparently produced only intermittently. They probably desert the original home to find fresh colonies elsewhere.

My experience of the "Ant Exterminator" is that this apparatus is of no use against *Calotermes* in tea bushes. It was found that the fumes would not penetrate the galleries, owing to the fact that they are blocked at intervals with earthy matter. The action of Carbon bisulphide would be limited for the same reason. Dilute phenyle, poured into the larger openings (when exposed by pruning), has proved useful in some cases. It appears to disgust the insects and prevent further extension of their work. But where a stem is badly infested, it is better to dig out the bush and burn it *in situ*, thus ensuring the complete destruction of the contained colony of Termites.

In my note (loc. cit.) I employed the term "worker" loosely. As explained above, these apparent workers are really full-grown larvæ.

E. ERNEST GREEN.

Camberley, 24th May, 1914.

(NOTE BY MR. RUTHERFORD.)

I did not write that the nests should be "found and destroyed." Surely when soldiers, workers and nymphs are present—and Mr. Green on one occasion found eggs in the galleries—there we have a nest! In his letter Mr. Green says: "Winged individuals are *apparently* produced only intermittently." In his journal he has left few records of the type of insects found in the galleries. But one reads—"one larva, two nymphs, and half-a-dozen winged adults;" apparently the apterous females are not always present, unless they are here included under 'nymphs.' A case of *C. greeni* is also of interest in this connection. A colony was obtained from the fallen branch of a tree (had this tree been tunnelled from the roots upwards?) and the colony in confinement produced "larvæ, soldiers, nymphs and winged insects."

It is thus possible that winged insects play a greater part in the dissemination of the insect than is generally supposed.

In the articles cited Mr. Green states that "the insects *apparently* effect their entrance through the roots working up first into the stem and later into the branches." So far as the writer is aware there are no facts which prove that the reverse direction may not be the true one.

With regard to dilute phenyle there is no record in Mr. Green's journals, as far as I can find, as to its having proved useful against *C. militaris*.

The supposition that the action of Carbon bisulphide would be limited for the same reason as that of the "Ant Exterminator" was limited, is not warranted.

I do not know that it has been demonstrated that "the apparent workers are *all* immature males and females."

Mr. Green still uses his terms somewhat loosely. How can a worker be a full-grown larva and at the same time an immature male or female? Perhaps by immature, potential is meant.

But, was Mr. Green aware when he wrote the article cited that the workers are potential males and females? There is nothing in the article to suggest that he was.

A. R.

HARDWOOD TIMBER.

The Solomon Islands contain some very valuable timber, but so far very little has been done to establish an export trade, although spasmodic attempts have been from time to time made to introduce it into the Sydney market. In this there has always been considerable difficulty, as, in spite of the increasing scarcity of timber in Australia, there seems to be a prejudice among those connected with the business against island timber. A market has at last been found for "dilo" timber, scientifically known as *Calophyllum inophyllum*. It is believed to be used in furniture making. Of this timber there is a practically inexhaustible supply. The timber of the tree *Afzelia bijuga* appears to be absolutely impervious to the attacks of white ants, and to those of the *Teredo navalis* almost so. This tree grows everywhere in the Solomons and reaches a diameter of 2 feet. One well-authenticated case is known of a house post of this timber having been in use so long ago as 1863, and the post is still sound. Such a timber would be apparently invaluable for railway sleepers or for wharf piles. Another valuable timber closely allied to the "kauri" of New Zealand, is known to exist in certain places, and proposals to turn it to account are under consideration. There is a good demand for this class of timber locally, and it could certainly be put on sale at a lower price than at the exorbitant rates demanded for New Zealand kauri by the Sydney merchants. A small saw mill was at one time working on the Guadal canal, and the government gave an order for rough timber which turned out to be of a most satisfactory quality for the purpose for which it was intended, but an order for a further supply could not be executed. Another saw mill has recently been started, and the owners should be able to dispose locally of all they can cut.—Chamber of Commerce Journal.

[*Calophyllum inophyllum* is the Domba, the wood of which is much used in Ceylon, while its fruits are the "Punnai nuts" of commerce—Ed.]

POULTRY.

THE STALENESS OF BREEDING STOCK.

BY H. HEBRON.

Many people will now have a large number of chickens out; they will have been hatching eggs from certain pens of fowls for quite a long time; but they cannot hope to prolong the breeding season month after month and get first-class results. The stock birds commence to tire, and possibly before long the eggs will be hardly worth incubating. Still, when the birds show signs of staleness in April and early May, just in the height of the season, it is often most serious for the poultry farmer; there is a big demand for chickens, hatching eggs are still good to sell, and a determined effort should be made to keep the stock-birds in tip-top condition so that the eggs will be fit for incubation, and likely to hatch out satisfactorily.

When a flock is run-down, the pullets can be seen lurking under hedges, they do not appear eager for their food, and, unless the day is very bright, many of them will remain most of the time indoors. Take a glance round your stock birds, see that all of them are fairly red in the comb, handle them to see that none is exceptionally fat. Those poultry-keepers who persist in giving a lot of soft food during the spring months will surely pay for it. It may have a tendency to increase the number of eggs, but it does so at great cost from a breeding standpoint. Big supplies of nourishing soft food soon induce laziness, which is usually followed by the birds getting into overfat condition; liver trouble may set in, and even male birds will not perform their work properly on such a diet. Over-feeding must be carefully guarded against.

Birds which have free range on good grass land, where vegetable and insect life is abundant, should not have more than one full meal daily; and it is better if this be served in two parts, a little early in the morning and late at night. Sound English wheat should form the principal grain used. This can never do any harm, since it will not overfeed the birds; indeed, it will induce a fairly plentiful supply of eggs, which will not only be more fertile, but in which the germs will be stronger, and which will hatch out much better with a reduced number of "dead in shell." Persons engaged in breeding operations do not require the largest number of eggs; it is more important to them to get a fairly good supply, but with almost every one strongly fertilised. And this can only come where the stock birds are properly attended to, decently housed, and, of course, kept in the best possible breeding condition

Insects will soon be prevalent. Once fowls get attacked with these pests it is surprising how quickly they go off form. I have seen dozens and dozens of infertile eggs laid by a pen of fowls that for a time were in sound condition, but unfortunately were attacked with insects. The male bird was almost worthless, and of course the eggs for hatching purposes were a downright failure. It is a good plan to have a change male bird for every pen. Run

each on alternate weeks, and when the resting period is on, feed him on most nourishing soft food, with a fair supply of cooked meat. Do not stint the supply given to male birds.

Just now there will be many birds producing double-yolked eggs, or eggs with soft shells, possibly laid from the perch. These complaints are always more prevalent during the height of the laying season than at any other period. Sometimes the soft-shelled egg habit is brought about by fright; a dog, for instance, may enter the pen, and anything of this kind has a tendency to encourage the birds to lay these eggs; but in nine cases out of ten it is excessive feeding on hot, soft food which is at the root of the evil. Breeding stock cannot be expected to keep in the best possible condition for any length of time. Three months at a stretch is an ample period to breed from the same pen of fowls. If a further lot of chickens is required, all the stock birds should be removed to fresh land, or, better still, be given an entire rest with change of diet. It is surprising how beneficial this rest proves in many cases.—Poultry.

THINGS TO REMEMBER.

Irregular feeding is often the cause of many disorders in poultry.

Charcoal is cheap enough, and is an excellent thing for poultry.

The absence of green food means an undesirable pale colour in the yolks of the eggs.

Laying hens should have all they can eat, and this should be of a high grade character.

In hot weather it is no indication that the fowls have had enough if they leave their food.

Neglecting to give fowls a regular supply of water is a serious matter. Dark combs are often an indication of neglect in this respect.

Sudden changes in the system of feeding are often responsible for vexation and loss. Any contemplated change should be made by degrees.

Cockerels to be fattened for the market should be fed well from the first, and confined in a small space. They will be profitable only when turned off in the shortest possible period.

Do not waste feed on unprofitable stock. It is only when the returns show a profit over cost of production and keep, that birds should be retained.

It is impossible to raise vigorous stock if these are not kept in the pink of condition. Protection from climatic extremes, absolute cleanliness, and a good supply of green feed are essentials to this end.—Feathered Life.

COTTON-SEED MEAL FOR HENS.

The Mississippi Station Bulletin recently reports on the value of cotton-seed meal for laying hens. This is also noted in the Experiment Station Record (Vol. XXX, No. 3).

This bulletin is a preliminary report of experiments in progress. Results of six months' work tend to show "that cotton-seed meal used as the chief source of protein is palatable to fowls, and that when fed judiciously on it they will produce eggs; that hens fed on cotton-seed will produce eggs when eggs are highest in price; that as far as can be determined, the general condition of the cotton-seed meal-fed fowls seems just as good as the condition of those fed on beef scrap; that the tendency was to lose flesh and not get over-fat, although the fowls were allowed access to the feed at all times; and that there is a good margin of profit from hens when given a properly balanced ration."—AGRICULTURAL NEWS.

CAUSES OF INFERTILE EGGS.

It is probably only a matter of a few weeks until the complaint will be heard in all its monotony, "Why are so many eggs infertile?" A little advice at the outset, before the eggs are wanted for hatching, may be of service in giving warning against some of the causes of sterile eggs. Only in this way can they be avoided. There are constitutional weaknesses over which the poultry keeper has no control, and other failures which cannot be anticipated. At the same time, there are many cases of infertility that are due entirely to bad management during the important period of producing the eggs.

TOO YOUNG PARENTS.

A large number of infertile eggs are due to the use of immature breeding stock. This is a fatal mistake, especially when breeding early in the year. Steps should be taken, as far as possible, to ascertain the age of the male birds before purchasing them. The ages of pullets are readily estimated, since this is a matter entirely in the hands of the poultry keeper himself, as he usually breeds his own. The males, on the other hand, have to come from an outside source. It is a very wise measure to deal only with those in whom trust must be placed, because, unfortunately, credence is not always to be placed upon the word of the seller. If the males are obtained in the autumn or early winter there is not much danger of getting young stock, since the appearance of the birds gives a fair idea as to the time of year when they were hatched. On the other hand, if the males are obtained just on the eve of mating, there is no guide in the appearance of the birds as to whether they were hatched in February or May. This may, and often does, make all the difference between infertile and fertile eggs. A further reason why the male bird should be obtained some time before he is to be used is in order that he may get accustomed to the altered conditions, and become thoroughly acclimatised before entering the breeding pen. It is frequently noticed that for two or three weeks after the arrival of a new cockerel he goes "off colour," and is quite useless in the pen. The reason for this is that he has the dual strain of the breeding pen and change from that to which he has been accustomed.

BREEDING STOCK TOO FAT.

A cause that is rarely suspected is that the male birds are too fat internally. Not only does this tend to infertility, but it is the cause of chickens being found dead in the shell. In every stage of the fowl's life internal fat is bad, but never more so than in the breeding season. It must not be inferred that the birds should be starved into a lean condition for breeding purposes, for this would be quite as bad as erring in the opposite direction. They may be brought into the proper breeding condition by giving foods of the right kind. Food must be of strengthening nature, and everything that tends to store up fat must be studiously avoided. It must be remembered that the sexes are brought together in the breeding pen. Although a fairly good yield in eggs is wanted, yet numbers are not the first consideration, and consequently food should not be of the same nature as that given to the general laying flock which is kept without males and forced to lay the market egg. A different object is the view for those occupying the breeding pens, and a limited number of eggs that have naturally matured and are produced in due order without forcing, are the eggs that show the highest percentage of fertility. The parent stock, fed principally on hard corn—preferably wheat and oats—will maintain the hardy condition so essential in stock birds.

NUMBER OF HENS WITH MALE.

This is a question upon which there exists a great diversity of opinion, and it is one that cannot be settled off-hand with an answer that would be universally suitable. Not only do breeds vary greatly in their fertilising capacity, but individualism has to be considered. One one point, however, all are agreed. The non-sitting breeds can take several more hens than can the heavy and less energetic varieties. It may be accepted as a general rule that eight to twelve hens may be allowed to run with such breeds as Leghorns, Anconas, Campines, and those of similar characteristics, while seven or eight will be sufficient for birds of the Plymouth Rock type. Furthermore, and this applies to all breeds, the number running with the male should be fewer early in the season than may be allowed when the year is more advanced.

HOUSING THE BREEDING STOCK.

It is no uncommon thing to see the selected breeders roaming at large throughout the winter in cold and exposed places, where little or no shelter is available. This is a mistaken method to adopt if fertile eggs are to be secured in the early spring. The past two or three months have not been remarkable for severity, consequently no harm would follow the free range system. As a matter of fact they would be better if so kept until mating, but during a cold or snowy spell it is essential that the fowls should be brought nearer to the farm buildings for shelter. During the breeding season it is desirable that the birds should be confined. This, however, is only necessary until the eggs have been secured that are intended for hatching purposes, when the birds may be liberated if desired, and the male birds removed. Comfortable and warm housing has more to do with obtaining fertile eggs than is generally imagined.—Feathered Life.

CHICKENS IN SPRING.

When the sun shines on the chickens and the earth is teeming with insect life, and part of creation bursts into being to feed another part, and a lot of the little birds are luxuriating in a dust-bath and opening their feathers to the sun, I like to see a fly of some sort pass just over them. Up they jump and away they go; their little necks are stretched to the full extent until one catches it. If it be large enough to require the captor to stop in order to swallow it, the sight of it in his beak makes him the envied of all the others. And although the event is not so disastrous to him as it has been to the fly, he has to suffer the same chase. Very often he goes until he is "out of breath," and he is obliged to drop his prize, which becomes the prey of another.

Let the hen give her danger call while the chickens are dusting; see how they start, and mark the clouds of dust they raise. I am fond of watching these things, and childish as they may seem, I dwell on them, because they are in reality essential to the well-being of chickens. They multiply troubles who would improve or teach Nature. When I see chickens brought up on the hot-house plan and seldom allowed to get fresh air, I cannot help contrasting them with the healthy rogues basking on a naked but dry bank, and bearing all the inclemency of the early months. Only one thing really torments me, and that is snow. Save me from snow—no scratch for hens or chickens, no grubs, no worms, no insects. The food sinks in deep, and chickens have not the reindeer's gift of foraging under the snow or of smelling through it.

I like chickens when they are strong, hearty, and defiant; and I cannot bear to see them brought up by being coddled. These latter, when turned out in the east winds of March, are poor little things. They step daintily about, picking some crumbs of choice food, and then listlessly settle down; the head sunk between the shoulders, wings and tail drooping, standing like a heron watching for fish, and changing their position only when, with a pitiful 'peep," the head is put under the wing.

East winds are bad for chickens that have been brought up in the lap of luxury; and they are not the best kinds for those which are roughing it in Nature's way.

What a change comes about with a change of wind! Many years ago, when smuggling was more thought of, because it was what was called "a hanging matter," an old friend of the family—no, not a friend, an acquaintance—did "a little in that way." He was a fine, shrewd fellow, but what with being exchequered, running ashore, and losing cargoes, he left off while yet young with more rheumatism than money. The east wind used to send him to bed; but he was often heard to remark while there, after weeks of confinement, that he felt a change of wind in the night, and his joints softened. I think oftentimes that chickens do the same—they are joyous fellows in the morning, while they had been sore grumblers the previous evening.

In winter time I have had chickens living in a barn, where with rips a sort of eastern yard was formed, presenting a square inside of open front, while the backs formed the defence against east winds. Just as a certain character,

having nothing but herrings to give his mother, persuaded the good woman it was always Lent, so I, thinking bed was the best place for them in winter, kept them much in darkness, persuading the hens it was night. This did well for a time, but the moment the weather changed they burst the bonds; they flew over the barriers; they snuffed the sou'-wester through the chinks and crevices, and I let them out.

I have them now under a hayrick, along a dry bank under a quickset hedge, and on the gravelled walks of a kitchen garden. After much experience I am convinced that chickens are good gardeners. They live much among the strawberries; they turn over every leaf, they are continually seeking for grubs and insects, and they do no damage. They are growing fast, and while I watch them daily I say to myself, I will make a note of this.

T. C. W. in Poultry.

GREENSTUFF.

The following extract is from a paragraph contributed by Mr. James C. Breakey for which he was awarded the weekly prize of five shillings offered to the readers of Feathered Life.

Even those poultry keepers who do not possess gardens, or who cannot gather the wild herbs of the country, need not despair of securing green food for their poultry. The simplest method for those so situated is to provide sprouted grain. This method of providing green food, so largely adopted within recent years, can be highly recommended, and is well worth a trial. Secure a number of boxes about 3 inches deep and of whatever length and breadth you wish. Cover the bottom to a depth of ½ inch with good grain—short oats are the best to use but other grain will do. Then flood the box with tepid water in order to saturate the grain. When the water has drained away the boxes must be placed in a warm atmosphere—a kitchen shelf or green house if you have one. The grain must be watered every day, just sufficient to keep it damp, and it ought to be stirred occasionally until it commences to germinate. In about ten days—less or more according to the heat—the green shoots will be about 3 inches high, and the whole is ready for use. The sprouted grain, together with the roots, should be chopped up and given to the birds as desired. Sprouted grain is a perfect boon to the town poultry keeper, and is well worth a trial by those who have any difficulty in securing that necessity to poultry health—green-stuff.

SOME USEFUL PARAGRAPHS.

CLEAN FOOD FOR EGGS.

Just because an egg is freshly laid by an apparently healthy hen it cannot be assumed that it is a good egg, according to Mr. James G. Halpin, of the University of Wisconsin, who emphasises the need of clean, wholesome food for the production of first-class eggs. Hens that are forced to obtain the

greater proportion of their living as scavengers and given a poor range to work on cannot produce eggs of as good quality as can a flock which regularly is fed a good ration.

Eggs lacking in protein have a watery white and the shell is apt to be thin owing to the partial absence of lime. Such eggs, besides being of less value as a food, are more than likely to bring forth puny chickens of low vitality, subject to white diarrhœa and an early death. With proper quantities of wheat, bran, clover, oyster shell and sound grains in the ration given to laying hens, eggs with firm shells, rich in protein and delicately flavoured, are sure to result, providing, of course, that the flock is given clean nests and runs and is kept free from mites.

GOOD EGGS.

The old notion that "eggs is eggs" no matter of what variety or how produced, is fast dying out; still there are a great many persons among those who should know better who do not realise the effect of food on the quality of egg. There is just as much difference between the eggs of fowls allowed to roam and forage for themselves, and those which are fed regularly on good, nutritious food, as there is between a leg of good Southdown mutton and that of a common half-starved sheep.

Fowls roaming over the farm and through the stable, expected through the summer months to pick up a living for themselves, eat many things they otherwise would not touch, and this strong rank food affects the flavouring of eggs; the same as when a cow eats onions, cabbages or turnips, the milk at once receiving the bad flavour. Eggs thus tainted in flavour have not the same keeping qualities as those from better-kept fowls. The richer the food, the better flavoured and higher coloured the eggs. Wheat and Indian corn, with a little animal food—scraps or cooked lights—twice or thrice a week, if the fowls are on a grass run, will produce the best quality of eggs for the table.

If the fowls are confined in a small yard with no access to grass, green food must be provided for them. A small feed daily of chopped grass or clover, with occasionally a head of lettuce or tender cabbage, will be a great benefit. Buckwheat is good to promote the increase of eggs, but it does not add to their richness. The yolks become pale, and if much of this grain be used the eggs are not desirable for pastry, and are unfit for some kinds of confectionery. Oatmeal and Indian meal mixed and scalded add both to the production and quality of the eggs, but care must be taken not to feed too liberally, or the increase of fat will check the production of eggs.

A. S. P.

VALUE AND PRESERVATION OF HEN MANURE.

A recent bulletin of the Maine Agricultural Experiment Station shows that the poultryman or farmer can materially add to the profits of his business by properly caring for the droppings of his fowls. For example, it is shown that the droppings from 1,000 fowls if preserved without needless loss are worth at least £60 per annum, and this estimate is based on the assumption that less than half of the droppings, or only thirty pounds per hen per year, can be collected.

According to the Maine station, the droppings should be collected daily and mixed with substances which will (1) prevent loss of nitrogen, (2) add sufficient potash and phosphoric acid to make a better balanced fertiliser, and (3) improve the mechanical condition of the manure so that it can be applied to the land with a manure spreader.

This can be done as follows: To each thirty pounds of the manure add ten pounds of sawdust, good dried loam, or peat, sixteen pounds of acid phosphate, and eight pounds of kainit. Such a mixture will contain about 12·5 per cent. of nitrogen, 4·5 per cent. of phosphoric acid and 2 per cent. of potash which, used at the rate of two tons per acre, would furnish fifty pounds of nitrogen, 185 pounds of phosphoric acid, and eighty pounds of potash, and at the present price of fertilising ingredients is worth about £2 3*s*. per ton. The mixture would furnish a well-balanced stable fertiliser, which, although not fine enough to work well in drills, can be successfully applied with a manure spreader. The treated manure should be well sheltered until time to apply to the land—that is, shortly before ploughing.

FEATHER PLUCKING.

Although I have an abundance of room for my fowls I am obliged to keep them within limits, because I raise eight varieties, and every year I have some cases of feather plucking. I have discovered a method of combating this vice, which has proved successful in every case. I make a paste of vaseline and powdered aloes and work it into the plumage of the birds which are being plucked, all around the plucked area. This paste is intensely bitter, and after a hen has plucked one feather which has been treated she is satisfied and gives it up. It is amusing to watch a feather-plucker when she gets a treated feather in her throat. She first gasps, then she wipes her beak in the straw or tries to scratch the bitter taste out of her mouth with her foot, and for several minutes comes as near making wry faces as a hen can. As my hens usually begin on the males I have no trouble about plucked hens, since I began using this mixture.

DUSTING PLACES FOR FOWLS.

Fowls, young and old alike, must dust! On the surface the runs are dry enough to provide the birds with dusting holes in odd corners out in the open. Few there are who do not enjoy "bathing" to the full these days. The smallest of our chicks are in the fashion as soon as the warm and dry weather sets in. They scratch holes in the earth and wallow in it to their heart's content. Indeed, so much do they indulge in dust baths in the sunshine that anyone not understanding the habits of fowls might imagine them to be sorely troubled with lice! And yet there never were cleaner birds.

It is the time of year for sunning and dusting, and fowls of all ages delight in it. In grass runs it may be difficult to allow the birds full scope in this direction. All is well if there is a hedge-row accessible, or some well-grown bushes. However, when such means are not to hand, one must contrive. A dusting box in a small shed is often more bother than it is worth, and better that the box be in the open in a sunny corner. A good dust hole can be made by removing a large turf and just loosening the earth with a garden fork. Make the space big enough for half-a-dozen fowls, and after loosening the earth shake into it the soil from the lifted turf. The birds will take to it as a duck to water; it is Nature's way of keeping them clean.

WHAT EVERY POULTRY-KEEPER SHOULD KNOW.

Don't allow male birds to run with the hens after the hatching season is over.

Eggs cannot be produced without nitrogenous food in some shape. Bones are absolutely essential.

Roosts so narrow that birds must be continually straining to keep their balance will cause them to lay soft-shelled eggs.

Charcoal is good for poultry, having a healthful influence over the whole system. They will eat much of it when placed within reach.

In selecting ducks for breeding, size of frame, length of body, and general activity should be looked for. Without size of body we cannot expect to obtain large ducklings.

Usually not enough attention is paid to the family history of fowls for breeding purposes, as regards their health. Constitutional weakness, though it be apparently overcome, should never be allowed to enter the breeding pen.—POULTRY.

DRY FARMING.

CULTIVATION OF THE SOIL IN ASIA MINOR.

Progress in Agriculture consists sometimes in retracing one's steps.

In a report of great interest by M. A. GREY, on the economic situation in some places in Asia Minor, we read that "Native agriculture presents in the region of Caiffa and St. Jena d'Acre two paradoxical appearances : cultivation in general is carried on without manure, and in summer without water (rain being completely absent from May to September).

The nature of the soil makes good these two wants, combined with intelligent working by the 'fellah.' Nitrification of the soil is effected by wild leguminous plants (Ononis, Calycotome, Lathyrus) which the Arabs preserve when ploughing : shortly before the weed seeds ripen, the 'fellah' pulls them up, leaving only those which improve the soil. This production of available nitrogen is increased further by some small fungi and moulds whose development in the layer of soil tilled is favoured by the special treatment of the 'fellah.'

The latter, in fact, prepares the earth to receive a large amount of winter rain and to retain it as long as possible. He does so by ploughing to a depth of 4 to 6 inches between each of the three or four rainy periods which succeed one another from November to April, when the winds from the South and South-West bring the rain, and by taking care to inter-cross the furrows so as to diminish the capillarity of the soil.

These precautions are not observed for winter crops, hence drought is feared much more for these latter than for summer crops, and sowing is carried out early, from October on, if the rains give evidence of their approach.

Sowing of summer crops is made after the last rains. The sowings are made on the under layer of hard earth by means of a tin funnel fixed to the plough, whose point is joined to the extremity of the ploughshare, consequently at a depth of 4 to 6 inches, under the layer of finely divided earth.—BULLETIN AGRICOLE DE L'ALGERIE.

GENERAL

ACACIA DECURRENS.

[*See Frontispiece.*]

After the opening of the Hakgala Garden as a cinchona station in 1861, endeavours were made to increase its usefulness by the introduction of trees and plants from Australia and other temperate and subtemperate countries which were likely to flourish in up-country districts. Among these were numerous species of *Acacia*, so many that the list, which is constantly being added to, is now quite a lengthy one. Many of these, of course, did not survive, but, of those that did, two at least have proved valuable acquisitions.

The most valuable of these is *Acacia decurrens*, which derives its name from the two lines which run down the stem from the point of insertion of the leaf. As every planter knows, it is one of the "feathery leaved" species, as distinguished from the species with "simple, entire leaves." The latter structures are, of course, not true leaves, but phyllodes, i.e. flattened and expanded leaf stalks. The transition from leaves to phyllodes may be seen in seedlings of *Acacia melanoxylon*. Of the commoner Acacias in Ceylon, *A. decurrens* and *A. dealbata* belong to the former group, and *A. melanoxylon* and *A. longifolia* to the latter.

The date of introduction of *Acacia decurrens* does not appear to have been recorded. There is a record of *A. decurrens* var. *normale* in 1891, but the plant had been introduced some years prior to that date, as the Hakgala report for that year states that some of the flower beds were then choked with its roots.

Acacia decurrens furnishes one of the best known tanning barks. It has been grown for that purpose in Ceylon, by Mr. Kellow of Albion estate, but the experiments showed so small a margin of profit that any idea of cultivation on a large scale was abandoned. More recently, it has been largely planted as a wind belt and for green manuring on tea estates down to an elevation of about 4,000 feet, and, provided that it is not allowed to grow so large that its roots interfere with the tea, it would appear to be admirably adapted for the purpose.

It has been repeatedly noted that in *Acacia decurrens* we have a tree which could be cheaply employed for the re-afforestation of patana lands, provided that the periodic burning of the latter could be controlled. The boundary belt of the Hakgala Gardens, which was planted in 1901, will afford an illustration of its rapidity of growth on such lands, and, especially on the southern boundary, of its ability to spread from self-sown seed. Where the ravages of fire and cattle are prevented, seedlings spring up in all directions. One possible objection to its use for this purpose lies in the probable difficulty of finding a suitable successor to the *Acacia*. The latter being a quick grower, it would be necessary that it should be followed by other more permanent species. But the mass of interlacing *Acacia* roots, which kill out practically all the undergrowth, might be expected to prove an obstacle to the establishment of other species, especially if natural reproduction had to be depended upon.

Of recent years, *Acacia mollissima* has come into vogue as a producer of tanning bark, especially in South Africa. From a botanical standpoint this is not regarded as a distinct species, but as a variety of *Acacia decurrens*. This does not mean that the tree so named does not yield a product which is better than that of the normal *Acacia decurrens*, but that the two plants grade into one another to such an extent that an exact line of demarcation cannot be drawn. As is well known, any species may show varieties, which may differ considerably in economic value, though the botanical differences may be very slight.

Acacia decurrens was formerly divided into three varieties, of which the chief are var. *normale* and var. *mollis*, the latter being what is now known as *mollissima*, which is a revival of an earlier specific name. Variety *normale*, known as the Black Wattle, has its young shoots glabrous or slightly tomentose pubescent, and its leaflets long and narrow, usually three to four lines long, while variety *mollis* has its foliage softly tomentose pubescent, a covering of golden yellow hairs on the young shoots, and obtuse leaflets, 2-3 lines long.

Acacia mollissima was introduced into Ceylon, under that name, in 1907, while *Acacia decurrens* var. *normale* was received in 1891. But there is no doubt that *mollissima* was received at a much earlier date, probably in the original consignment of *Acacia decurrens*, no distinction having been made between the two varieties. There is a specimen of *A. mollissima* in the Peradeniya herbarium which was collected, in flower, at Hakgala in 1888. Examination of trees there shows that many of them are referable to *A. mollissima* on the character of the golden yellow covering on the young shoots, and it is probable that the same will be found to be true of those on estates. This character is, however, very variable, and all degrees of density of this covering may be found. The distinction between the lengths of the leaflets appears to fail in Ceylon, none of the trees examined having had leaflets greater than the measurements given for *A. mollissima*, even when the yellow tomentum was completely lacking.

Acacia pycnantha which is said to yield a better bark than *A. decurrens* has been introduced into Ceylon, so long ago as 1884, but it does not appear to have survived at Hakgala, a careful examination of the Acacias there having failed to reveal any example of it.

With the extension of the cultivation of *Acacia decurrens*, several diseases of the tree have made their appearance. An account of two root diseases has already been published in the Circulars of the Royal Botanic Gardens. One of these, that caused by *Armillaria fuscipes* is apparently rare, though the fungus is not uncommon in up-country jungles. The other, caused by *Fomes australis*, is more frequent. This latter fungus is very common in all parts of the Island. The up-country forms of it differ in some respects from those found in the low-country, chiefly in the deep vertical margin of the older specimens. It apparently attacks *Acacia* only through wounds on the larger roots and at the base of the stem. As a saprophyte, it is very common on *Acacia* stumps.

A stem disease has been reported from one district. One of the smaller side branches dies back and the bark of the parent branch, or the main stem, as the case may be, becomes sunken round the point of insertion of the dead twig. The dead bark overlying the sunken patch ultimately splits, and a true "canker," i.e., an open wound bordered by a swollen margin results. This disease is apparently caused by a *Nectria* and is identical with a disease of *Albizzia* which exhibits exactly the same features.

T. P.

THE DATE PALM

An easy and well paying culture, produces delicious fruit of great food value at low cost and with a small labour force.

From the **Official Report** of an Agricultural Department we take the following notes:

"It is confidently believed that date culture is one of the most profitable fruit industries and that it will pay to plant date palms on the best lands employing modern horticultural methods.

The amount of labour and care required by the date palm is much less than that necessary for any other fruit trees. The gathering of the fruit is performed easily and quickly by cutting off a whole bunch at a time.

"The Date Palm is almost as important as a shelter and partial shade for other trees and plants as it is for its own fruit."

We Supply Date Palm Seeds of two varieties at the following prices:

Phoenix D. Sapida, a strong and resisting tree, demands no special care, but yields plenty of nice and soft fruit:

On receipt of 3 Shillings we forward about 10 ounces seeds (in full fruit) as sample of no value, under registered postage paid.

On receipt of £1.-,—Sterling=10 lbs. nett, by parcel post, postage paid.

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On receipt of 3s. 6d. we forward about 10 ounces seeds (in full fruit) as sample of no value, under registered postage paid.

On receipt of £1.5.--Sterling=10 lbs. nett, by parcel post, postage paid.

Prices for quantities on application. Detailed instructions for cultivation with every order.

Never buy Date Seeds in Kernels, as such, i.e.. without the pulp, they easily lose the germination power and offer no guarantee that the trees will produce soft dates, for a dry or hard date is absolutely valueless.—We therefore supply date palm seeds only in the original fruit.

GEVEKOHT & WEDEKIND, Hamburg 1.

LEAF DISEASE OF CELERY.

During the last few years, a leaf disease of celery has been very prevalent in the Nuwara Eliya district. It was collected by the Mycologist in the vegetable garden at Hakgala in 1912, and since then it has been sent in by correspondents who have been accustomed to grow this plant in their gardens.

The particular disease in question is known as "Late Blight" of Celery, so called because it was supposed to be most prevalent when the plants were full grown. DUGGAR states that it is most injurious as a rule during early autumn, though a few spots may be seen at any time during the summer where it is at all prevalent. It is destructive in the field until the plants are lifted, but the fungus may continue to flourish after the plants have been stored. This last phase, however, is not of interest here in Ceylon.

Late Blight is said to be a comparatively recent disease in the United States, and DUGGAR in 1909 stated that it had not been considered a serious disease of celery in Europe. This situation appears to have undergone a sudden change, and the journals devoted to vegetable growing are now calling attention to the serious spread of this disease, both in America and Europe. Ceylon is, therefore, merely sharing in the general epidemic.

The reason why this disease has spread in Ceylon coincidently with the epidemic in Europe and America is not far to seek. It is practically certain that the fungus is distributed with the seed. Chittenden, in England, states that of 33 samples of Celery seed examined in the Wisley laboratory in 1913, fourteen showed the pycnidia of the fungus upon the seeds or pieces of stalk mixed with them, and microscopical examination showed that these pycnidia in the majority of cases still contained spores. Some of the diseased seeds had been grown in England, and others on the Continent. Several commercial samples of Celery seed were washed with distilled water, and the spores of the fungus were found in fifty per cent. of the washings. Klebahn has shown that washings from seeds saved from diseased plants contain spores of the fungus, and by spraying healthy plants with these washings he has infected them with the disease. He believes that the sowing of seeds containing the spores of the fungus is the principal, if not the only, means of spreading the disease.

As far as Ceylon is concerned, confirmation of the supposition that the disease is introduced with the seed is afforded by the fact that we have no native plant allied to Celery on which the fungus could exist. It must be remembered that in the case of Celery the so-called "seed" is really the fruit, and retains, when ripe, its original outer coat. The possibility of the persistence of the fungus is thus greatly increased.

In addition to its increased virulence, the disease appears to have changed its character as far as regards its time of appearance. It now no longer deserves the name of "Late Blight," as it may make its appearance quite early in season. The first leaves of the seedling may be infected.

Pethybridge, in the Gardeners' Chronicle, stated that 90 per cent. of the Celery seed on the market is infected with this disease. American seed is often free from infection, but American varieties of celery are not regarded as suitable for cultivation in England. He states that in two-year-old seed, the spores would probably have lost their power of germination, but unfortunately the germination of celery seed falls off considerably in its second year.

Treatment with 0·3 per cent. formalin or with hydrogen peroxide (10 to 20 volumes) for three hours is sufficient to kill the fungus without injury to the seed.

The first signs of the disease on the celery plant are small scattered palish spots on the leaves. These spots turn brown, and become dotted with minute black points which are the fruiting bodies (pycnidia) of the fungus. Sooner or later, the affected leaves begin to wilt, turn brown, and curl up at the edges. The fungus in question is *Septoria petroselini* var. *Apii*.

Salmon, from the results of experiments carried out at Wye, states that three sprayings with Bordeaux Mixture (in June, July, August in England) will protect Celery plants during the growing period from the attacks of this disease. As the disease is liable to occur very early, even in the seed bed, it is recommended that seedling plants should be dipped in Bordeaux Mixture at the time of transplanting.

How far the "celery" grown in Ceylon is worth this trouble must be left for the would-be grower to decide. From the available evidence it would appear that the cessation of celery growing for two years would free any garden from the disease, and subsequent infection might be prevented by treating the seed by the methods recommended. In that case spraying would probably be unnecessary.

T. P.

A DROUGHT-RESISTING ADAPTATION IN SEEDLINGS OF HOPI MAIZE.

BY G. N. COLLINS.

A study of the maize grown by the Hopi, Zuni, and Navajo Indians of New Mexico and Arizona has brought to light an adaptive character that promises to be of economic importance in dry regions where germination is uncertain.

These south-western Indians have preserved from pre-Columbian times a type of maize able to produce fair crops in regions where the better known varieties of the East fail for lack of sufficient water. An important factor in the drought resistance of this type of corn is its ability to force the growing shoot of the seedling to the surface of the soil when planted at a depth of a foot or more. At such depths less specialised varieties die before reaching the surface.

The literature of corn contains reports of many experiments conducted to determine the proper depth of planting, but the results are confusing and contradictory. It has generally been realised that the optimum depth is influenced by differences in soil and climate, but that the proper depth might vary with different varieties seems not to have been appreciated. The experiments referred to later, as well as many unpublished data showing the varying behaviour of types when planted at different depths, indicate that it is unsafe and unscientific to generalize with respect to cultural factors without taking type, varietal, and even individual differences into account.

MORPHOLOGY OF THE MAIZE SEEDLING.

To explain this drought-resistant character, it will be necessary to discuss briefly the different parts of a maize seedling. The primary root, or radicle, which is the first organ to emerge from the germinating seed, is soon followed by the shoot or plumule. Inclosing the shoot is the cotyledonary sheath, or coleoptyle, a tubular organ which is closed and pointed at the upper end. Between the base of the coleoptyle and the seed the axis is somewhat elongated. With seeds germinated in the laboratory this elongation is so slight that it might easily be overlooked. Nevertheless, this small organ has not escaped the notice of morphologists, and its nature has been the subject of much discussion. It has been variously called "hypocotyl," "mesocotyl," and "epicotyl." By some it is held to be an internode, by others merely an elongated node.

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Studies of seedlings of Hopi maize show that the mesocotyl may frequently develop up to lengths of 36 cm., and it has been possible to note a fact which appears thus far to have escaped notice—namely, that the mesocotyl may give rise to roots at any point on its surface—but these roots are threadlike and do not resemble the roots that arise from the nodes of the culm. They do, however, closely resemble the roots that arise from the radicle immediately below the seed. In grasses, roots usually arise from nodes, not from internodes, and the presence of roots on this organ in maize distinguishes it sharply from subsequent internodes, and is an argument in support of the interpretation that this intercalary growth, long though it is, is really a part of the cotyledon and may properly be termed a mesocotyl. A further reason for retaining the term "mesocotyl" is because the interpretation implied by its use permits more direct comparisons with other groups of monocotyledonous plants, where the organ sheathing the plumule seems undoubtedly to be a part of the cotyledon.

From observations upon many varieties of maize it has become apparent that when a grain of corn germinates in the ground this usually insignificant organ is of vital importance to the life of the plant, for it is through the elongation of the mesocotyl that the shoot is enabled to reach the surface. So long as the seedling remains below ground, away from light, the mesocotyl will continue to elongate until it reaches a maximum length, which we have found to differ in different varieties, but which seems reasonably constant within the variety:—As the mesocotyl elongates, the coleoptyle, with its firm, sharp point, is pushed upward through the soil. As soon as the coleoptyle emerges from the soil, the elongation of the mesocotyl ceases, and elongation of the internode bearing the first true leaf begins, forcing open the coleoptyle.

If the seed is planted so deep that the maximum elongation of the mesocotyl, which in anatomical structure shows a striking relation to the radicle, fails to bring the coleoptyle to the surface, the task of penetrating the soil and reaching light devolves upon the first true leaves. In comparison with the sharp coleoptyle, these leaves are but poorly adapted for forcing their way through the soil, and if the tip of the coleoptyle stops more than a few centimeters below the surface these leaves usually crumple and never reach the light.

In the varieties of maize commonly grown we have been unable to force the mesocotyl to a length greater than 10 cm., while in the Hopi and Navajo varieties this usually minute organ has in our experiments frequently reached the enormous length of 25 or even 30 cm.

GERMINATION OF NAVAJO MAIZE.

It has been frequently stated that the Navajos, like their neighbours, the Hopi and Zunis, plant maize at unusual depths, 15, 30, and even 45 cm. having been reported. Since planting at such depths is known to be impracticable with other varieties, experiments were planned to test the ability of the Navajo maize to pierce the soil. A representative experiment is here reported. A box 70 cm. long, 33 cm. wide, and 34 cm. deep was sunk in the ground. A quantity of sandy loam soil sufficient to fill the box was slightly moistened and carefully sifted. At one end the box was filled to within 1 cm. of the top, the soil sloping in a straight line to within 1 cm. of the bottom at the other end.

Five seeds each of Navajo, Boone County White, and Chinese maize were placed in a row transverse to the inclined surface of the soil, 2 cm. from the top of the box. A similar row was planted at a depth of 4 cm, from the top, and so on at the following depths: 6, 8, 10, 12, 16, 20, 24, 28, and 32 cm. The box was then filled with the soil and struck off level

with the top. The seeds germinated promptly, and when the most advanced seedlings had reached a total height of about 60 cm. the plants which appeared above the surface were dug up, and the mesocotyl and coleoptyle were measured.

Twelve cm. was the greatest depth from which seedlings of the Chinese variety appeared at the surface. Seedlings of Boone County White appeared from all depths up to 20 cm., while plants of Navajo maize appeared from all plantings, including the very deepest, 32 cm.

There were numerous instances in which the combined length of the mesocotyl and coleoptyle was less than the depth at which the seed was planted. This, of course, means that the upper layers of the soil were penetrated by the true leaves. Maximum depth of soil thus penetrated by true leaves of the plants of the Chinese variety was 5 cm. One plant of Boone County White maize forced its leaves through 8 cm. of soil. In all of the Navajo plants the coleoptyle reached the surface.

The extent to which the seedlings of the Chinese and Boone County White varieties were able to penetrate the soil by means of the true leaves was doubtless much greater in the carefully prepared soil of the experiment than it would be under field conditions, where any slightly compacted lump of soil would deflect the tender leaves and cause them to crumple. On the other hand, many seedlings failed to come up where there was less than 2 cm. between the top of the coleoptyle and the surface of the ground. The results clearly show that the coleoptyle is the proper organ for penetrating the soil, and where this office devolves upon the leaves there will be many plants that fail to reach the surface.

It has been observed in many field plantings that the spatulate first leaf, formerly called the cotyledon, is the first evidence of the germinating plant. When this occurs in any considerable proportion of the plants it is safe to assume that the seed has been planted too deep for the best results.

The three types of maize used in the box experiment were also planted in the field. Four seeds of each of the varieties were planted as follows: At the surface and at 5, 10, 20, 30 and 40 c.m. below the surface. The greatest depth from which plants of the Chinese variety reached the surface was 10 cm., that of the Boone County White was 20 cm , while that of the Navajo was 30 cm.

The seeds planted at the surface were naturally the first to appear, but on June 17th, one month after planting, the largest of the Chinese variety were those from a depth of 5 cm., while the largest plants of both the Boone County White and the Navajo maize were from the 10 cm. depth. On July 11th the plants that came up from a depth of 10 cm. were the tallest in all the varieties, including the Chinese, and to the end of the season this appeared the most favourable depth for the Chinese and Boone County varieties. With the Navajo, however, the plants from a depth of 20 cm. white had equalled those from the 10 cm. depth before the end of July, and from that time the plants from the 20 cm. planting continued to make the most rapid growth, as though this depth represented the most favourable condition for the Navajo variety.

DESCRIPTION OF ROOT SYSTEM.

We have observed further that the root systems of the Navajo, Hopi, and Zuni varieties differ from those of the other varieties ; the roots of their seedlings extend to a greater depth, and there is only a single root arising from each seed, while in the seedlings of the Chinese and Boone County White varieties the roots are shorter and more numerous.

The roots of maize are of two kinds : Those that arise from the embryo or seed, called "seminal roots," and those produced from the nodes of the plant. Of the latter class those that arise from the nodes above the ground are often called "brace roots" or "ærial roots." In the varieties commonly grown in the United States there are, in addition to the primary root, or radicle, from two to six additional roots that arise from the base of the cotyledon. These secondary seminal roots, though appearing somewhat later, usually equal or exceed the radicle in size. In the Pueblo varieties of maize these secondary seminal roots have been absent in all seedlings thus far examined, the radicle being the only root arising from the seed.

FIELD STUDIES OF PUEBLO VARIETIES OF MAIZE.

In September, 1913, opportunity was afforded for a visit to the Zuni, Navajo, and Hopi Indian Reservations of Arizona and New Mexico. It was thus possible to form some idea of the agricultural significance of the peculiar habits of germination of this type of maize.

The value of deep planting made possible by the greatly elongated mesocotyl was obvious. In the localities selected by the Indians for planting maize the soil is sandy, and in the absence of spring rains the surface layers are, of course, very dry. The seed, to germinate at all, must be planted deep enough to be in contact with the moist soil. In Navajo fields near Tohatchi, N. Mex., plants were dug up, and the remains of seeds were found at depths ranging from 13 to 18 cm. below the surface. Similar depths were found in a Zuni field near Black Rock, Ariz. In a Hopi field at Polacca, Ariz., near the First Mesa, where the conditions are extreme, the seed had been planted at a depth of 25 cm. It thus appears that there is no fixed depth for planting, the custom being to plant deep enough to place the seed in moist soil. If the seed were planted at ordinary depths, germination might be delayed until the latter part of June or the first of July, at which times the rains usually occur; or if the seeds germinated as a result of one of the occasional showers occurring in May, the plants would die from subsequent desiccation.

Like the long mesocotyl, the simple radicle of the Pueblo varieties of maize may be looked upon as an adaptation to the extreme conditions that exist where these types are grown. For six or eight weeks after planting, no rain can reasonably be expected, and during this time the moisture is constantly receding from the surface. By concentrating the energy of the seedling into a single root the latter is forced to greater depths and consequently kept in moister soil than would be the case were a number of seminal roots developed.

Under ordinary conditions, where moisture is distributed through the entire seed bed, the seminal roots become of little importance as soon as the seedling is established and nodal roots have developed. If a half-grown or nearly mature corn plant is carefully dug up, the seminal roots and traces of the seed can still be found, but they are usually dry and shrunken and are obviously of little use to the plant. This was also the condition found in Navajo and Zuni maize fields, though the seminal root was more strongly developed than in the eastern varieties. But in the more extreme conditions existing in the fields near the Hopi villages, the seeds were planted deeper, and were still alive and fresh, making it apparent that they retain their function of supplying moisture and are able to play an important part during the entire life of the plant.

In one Hopi field at the base of the First Mesa the hills of maize were planted about 20 feet apart, with from 10 to 20 plants in a hill. The soil was apparently pure sand washed down by the winter rains and entirely destitute of vegetation other than the planted maize. An average hill dug up in the field was found to contain 15 plants ranging from 60 to 90 cm. in height. The remains of the seeds were found at 25 cm. from the surface, and from

each seed there descended a single large seminal root. These seminal roots were traced to a depth of 35 cm. and extended even farther down. They were still fresh and densely covered with fine branches. This mass of 15 seminal roots, while less in volume than the nodal roots arising near the surface, was apparently playing an important part in the support of the plants. The mesocotyls connecting the seminal roots with the plants above, while dry on the outside, were filled with live tissue quite unlike the dry and shrunken mesocotyls found in plants of similar age grown under more favourable conditions.

When planted by the Indian methods, the Hopi and Navajo varieties of maize have been found superior to the more improved eastern varieties for these very dry regions. At the time of our visit there was a small field near Keams Canyon that had been planted by eastern methods. The plants were in rows and thinned to one stalk to the hill. There had evidently been a fair germination, but the plants had died without reaching maturity and had produced no seed. At the same time, in the nearest Indian fields at Polaccas the plants were dark green and maturing a fair crop, though the season was said to have been unusually dry.

Even under irrigation the somewhat larger strains grown by the Navajos have been found to compare very favourably with eastern types. Several acres of Navajo maize were seen at Shiprock, N. Mex., under irrigation. The fields were very uneven, apparently the result of alkali, but in the better portions the yield was good. The plants were standing about 2 feet apart in the row, the rows 4 feet apart, and nearly every plant was bearing from two to four fair-sized ears.

The ears from 36 plants, representing a number of distinct types, were collected. The 36 plants bore in all 94 ears, weighing 37·6 pounds, an average of 15·2 ounces per plant. The plants producing these ears averaged only a little over 5 feet in length.

CONCLUSIONS.

Throughout the western part of the Great Plains area the difficulty of securing uniform germination is a serious obstacle to the growing of maize. With the varieties commonly grown, if the seed is planted at the customary depth, many seeds fail to germinate from insufficient moisture; if planted deep enough to come in contact with moist soil, the plant may fail to reach the surface.

The agricultural Indians of the south-west have continued from prehistoric times to grow maize successfully in regions where drought, and especially the absence of spring rains, makes it much more difficult to start the crop than in the Great Plains. A study of the varieties grown by the Hopis and other agricultural Indians shows that these varieties possess two special adaptations: (1) a greatly elongated mesocotyl that permits deep planting and (2) the development of a single large radicle that rapidly descends to the moist subsoil and supplies water during the critical seedling stage.

This indigenous type of maize seems to have attracted little attention, perhaps because it has been included in the popular mind with a series of inferior varieties commonly known as "squaw corn." But the Pueblo Indians of Arizona and New Mexico have strains sufficiently productive to compare favourably with improved varieties even when grown under irrigation. The peculiar adaptations of this type definitely indicate its value for the semi-arid regions and warrant experiments to determine the possibility of its utilization.

—Journal of Agricultural Research.

ARTIFICIAL MILK.

A discovery which should prove of great interest to housewives and mothers has recently been brought to perfection in a London chemical laboratory. This is a process of manufacturing synthetically a pure and wholesome milk of high nutritive value, possessing all the virtues of the original article but none of its many dangers.

The discovery originated many years ago as the result of the ingenuity of a Chinaman who saw a possible substitute for milk in the native drink prepared from the soya beans. His efforts, however, met with only partial success owing to the fact that the fluid prepared by him had an exceedingly penetrating and—to Western palates—disagreeable taste. It was left to a German chemist to lay the foundations of the present synthetic milk by suggesting a composite fluid, made up of all the ingredients of cow's milk in correct proportion.

This suggestion was widely discussed about two years ago, but the many obvious difficulties standing in the way of its realization caused the public to regard it more as a dream than a possibility. One or two chemists, however, attracted by the idea, continued to work at the subject, with the result that synthetic milk is now an accomplished fact!

TASTE OF THE NEW MILK.

The fluid (says the Times), as far as its appearance is concerned, is quite indistinguishable from rich cow's milk. It is delightfully smooth on the palate. On the other hand, the taste seems to some persons slightly different from that of ordinary milk. It is said that even this slight "taste" can be removed at will. A dairyman was recently asked to express his opinion of the new milk, and two glasses, one containing his own milk and the other the artificial fluid, were placed before him. He praised what he supposed was his cow's milk and expressed a very modified appreciation of the other. His surprise on learning of his error was naturally great.

INTRODUCTION OF BACTERIA.

The new milk has been built up from a basis of casein obtained from the soya bean. Casein, of course, is likewise the basal constituent of cow's milk. The beans are treated by a special process whereby all oil and waste matter are removed and only the pure casein left. To this basis are added in exact proportions fatty acids, sugars and salts and emulsification is carried out.

The difficulty of producing a perfect emulsion (milk is one of the most perfect emulsions known) has been completely overcome, the new fluid satisfying every test in this direction, even to the extent of refusing to "cream."

Milk, however, is something more than a food substance; it is a living fluid containing a definite strain of bacteria which assist in its digestion. In order that the synthetic milk may approximate in all respects to the real milk bacteria of the required strains, including the lactic acid (sour milk) bacilli rendered famous by Metchnikoff a few years ago, are introduced to the fluid and permitted to act upon it until it reaches exactly that state of what may be termed maturity at which fresh cow's milk is obtained. That it is indeed a real milk is proved by the fact that excellent cheese and "butter" can be made from it.

The advantages of the new milk are obvious. It is, of course, free from all suspicion of being contaminated with "milk-borne" diseases like tuberculosis, scarlet fever, or diphtheria. It can, moreover, be made up in any

proportions desired, that is, with more or less casein, fat, sugar, or salts, and thus can be supplied to children and invalids according to a medical prescription. Finally, the new milk can be produced more cheaply than any ordinary milk, and should thus prove a real boon to the poor.

The distinctive taste of the milk is due to the use which is made of the soya bean. It is almost impossible to describe it, since like the taste of celery or cinnamon it is peculiar to itself and characteristic. A sample of the milk was submitted to a food expert who has travelled extensively in the Far East, with the request that he would, if possible, name the ingredient imparting the flavour to it. Without hesitation, and with a smile at the pleasant memories recalled, he declared "Soya," and added: "The history of that bean is like a romance."

USES OF THE SOYA BEAN.

That this statement is no exaggeration is proved by the fact that while the first consignment of soya beans was sent to Europe so recently as 1906, to-day Western requirements are something like a million tons a year. The beans are grown in China, Japan, Korea, and Manchuria, where they have long been valued for their oil and for the waste products after the oil has been extracted, which are used as fertilizers in the rice and sugarcane fields. Vermicelli biscuits and other foodstuffs are also manufactured from the beans.

In this country the soya oil has now a very ready and extensive market. It is used instead of the cotton seed variety on account of cheapness. Soap manufacturers are also coming to depend upon it. The chief use, however, would seem to be as cattle cakes for winter feeding. That the article which has fed so many milch cows during the last few years should itself be used in the making of artificial milk is undoubtedly something of a coincidence.

Most of the soya beans entering this country pass through Hull, which, with its great oil and seed mills, is the natural centre for such a commodity. This import trade is already a very extensive one, the freights on soya beans having mounted up to a figure somewhere in the neighbourhood of £1,000,000 per annum. In addition a considerable export trade has recently sprung up owing to the demand of Continental dairy farmers for soya meal.—Indian Agriculturist.

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RED AND BLUE PIGMENTS OF FLOWERS.

The most beautiful colours in nature—the reds, blues, and purples of flowers and fruits—have withheld the secrets of their composition longest ; but, as the result of the work which Professor R. Willstatter (of the Kaiser Wilhelm Institute for Chemistry, Berlin) and his collaborators have carried out during the last three years, the chemistry of these pigments is now known.

So long ago as 1905 incentive to this work was given by H. Molisch, the distinguished Viennese botanist, who proved that these pigments—which were generally looked upon as amorphous substances—not only exist in many flowers in a crystalline condition, but may be isolated as microscopic crystals.

A paper published last year by Willstatter and Everest foreshadowed interesting developments in this field, but the rapidity with which the investigations have advanced must have surprised even the investigators themselves. Proof has now been obtained that, in all investigated cases, these colouring matters (the anthocyans) are members of one class of chemical compounds, and, moreover, that they are closely related to the colouring matters of many yellow flowers. This latter result is a confirmation of similar conclusions arrived at independently by various other workers.

To the flower-lover there are many points of interest which arise from this work, and a few such may be mentioned.

It has been shown that most of these pigments—which in themselves are purple—have the power of combining with acids to form substances which vary in colour from bright red to magenta, whereas, on the other hand, by uniting with alkalis, they give rise to blue colouring-matters. The horticulturist who for years has striven to obtain a blue Rose will be interested to know that these researches have shown that the colouring matter present in the Red rose is identical with that which imparts to the Cornflower its fine blue colour. The only difference between them is that in the red Rose the pigment is united with a plant acid, whereas in the Cornflower it is combined with potash. From this it appears that there is no reason why success should not ultimately attend the efforts of those who may devote themselves to the production of this novelty.

In like manner it has been observed that the pigment of the ordinary Poppy does not seem to possess the power of combining with alkalis to produce a blue compound, hence it would appear useless to attempt the production of a blue flower in this case—a variation from red to purple only being obtainable.

For years the deep red Hollyhock has been grown on a large scale in various continental countries, and the dried flowers have been used extensively for improving the tint of poorly-coloured wines. This adulteration led to many attempts being made to discover a method of detecting the presence of the adulterant, but in view of the very close resemblance between the pigments it seemed almost impossible to expect success, and previously all such attempts had failed. The work of Professor Willstatter, however, has shown exactly how the pigments of the Grape and of the Hollyhock are related to each other, and has led to a successful method—involving the use of ferric chloride—for distinguishing between these pigments.

In most cases the method of obtaining pure crystalline pigments from flowers has been reduced to a few very simple operations, e.g., it is often sufficient to extract the colour with alcohol containing either hydrochloric or acetic acid, precipitate it from this extract by the addition of ether, then take

up the solid so obtained in dilute hydrochloric acid, from which it separates in crystals. From the red Rose, crystalline pigment equal to 1 per cent. of the weight of dried petals can thus be obtained, whereas the Cornflower only contains about 0'6 per cent of pigment, and it is far more difficult to obtain it from this flower. In the Pelargonium zonale the amount of pigment rises to $6\frac{1}{2}$-$7\frac{1}{2}$ per cent. of the weight of the petals.

It has been shown that the power which these pigments possess of combining with acids is dependent upon oxygen, and not, as is so often the case in organic compounds, upon the presence of nitrogen in them. They contain no nitrogen.

For a long time differences of opinion have arisen as to whether or not these colouring matters—like so many naturally occurring compounds—exist in the plants in chemical combination with sugars. The researches above mentioned prove conclusively that they do.

Thus is added to the credit of the scientist the discovery of one of the most obscure of Nature's secrets, but, like most such work, it leads him on to further problems. His work has shown what these beautiful substances are; the problem now arises, How are they produced in the plant laboratory? Let us hope that ere long this question, too, may be answered.—ARTHUR E. EVEREST in THE GARDENERS' CHRONICLE.

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THE YIELD OF THE OIL PALM IN LOWER GUINEA.

BY L. NICOLAS.

The oil palm (Elaeis Guineensis) is one of the principal riches of French Guinea. It is found in abundance in the whole coastal belt and its products (palm oil and palm kernels) give rise to numerous commercial transactions, which increase from year to year.

The higher price commanded by oil products, and the falling price and lesser production of rubber are causes drawing attention to this plant at the present moment.

Many species of Elaeis are not yet exploited, even near the coast. Such is the case, for example, in the Los Islands situated opposite Conakry, where more than 100,000 oil palms are never touched.

The species of Elaeis are especially numerous and form dense groves at Bagataye and Cape Verga. In this region the Bagas exploit them regularly, and they form a constant source of revenue : in exchange for palm kernels they can always procure rice and cloth.

The oil palms are common property, or more exactly, are the property of a village or a canton.

I shall not give a botanical description here. It will suffice, from this point of view, to refer to the " Documents sur le palmier a huile " published by M. A. Chevalier ! I shall simply put on record that I have seen numerous fruit branches terminated by male flowers, and, in the Los Islands, an *Elaeis*, the stem of which was branched several times.

Having had the good fortune to remain attached for a sufficiently long time to the same post, I have been able to undertake a thorough practical study of the annual yield of *Elaeis guineensis*, and am fortunate to be able to give here, as exact details as could be wished for, on this question.

To collect the crop, the natives climb up the trees by means of an elliptical hoop made from the midribs of the leaves of young *Elaeis*. According to the local custom, a Bagas ought to make for himself the apparatus which he uses, and not employ that of another person, nor destroy his own when finished with : for, in the popular belief, whoever does not observe these rules runs the risk of killing himself in climbing the palms : also, the hoops when too old for further use, are deposited near the villages with the old pestles.

The natives, armed with a straight instrument having a cutting end, cut the fruit branches at the base, and throw them down to the ground. These are carried entire to the village, and left near the houses for fifteen days, to allow them to ripen completely. They are then cut up with an axe, and the fruits, thus detached, are laid in the sun for two or three days, in order to obtain absolutely complete maturity.

These fruits are then put in an earthenware vessel, of native manufacture, or in a big cast iron pot, previously filled with water, and resting directly on a fire of palm leaves. Under the action of the heat, the oil-bearing cells of the pulp burst, and allow a part of their oil to escape. The

fruits thus boiled are thrown into wooden mortars, where the women completely disintegrate them by pounding. The whole is finally emptied into the pot, and put back on the fire, with water already hot, and brought to the boiling point a second time.

This operation completed, the women take up the mass formed by the pulp and the kernels in their shells, by means of baskets with broad meshes, and empty it, after allowing it to drain, into another pot containing more boiling water.

On allowing it to cool, the oil rises to the surface. The pulp mixed with a few fruits also rises to the top. It is removed after being strongly pressed between the hands.

Finally, the heavier nuts are put on one side, spread out in the sun and broken one by one between two stones, and then well dried. The palm kernels thus obtained are put in sacks and sent to market.

The merchants buy the oil by the bushel of fifty litres : certain business houses on the contrary buy by weight. Generally speaking the palm kernels are bought by the bushel if they are wet, and by weight when they are dry.

The price of palm kernels, which was 280 francs per ton in September 1906, rose to 350 francs per ton in September 1912, on the market in Conakry.

The financial results of palm oil exploitation were published in the previous issue (Vol. XLII, No. 6, p. 490) of the TROPICAL AGRICULTURIST.

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BUENOS AIRES BOMBAY

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THE CEYLON

STATEMENT OF RECEIPTS AND PAYMENTS FOR

RECEIPTS.			Rs.	Cts.	Rs.	Cts.
TO BALANCE AT BANK OF MADRAS, &c., 31ST DEC. 1912					38575	54
,, MEMBERS' SUBSCRIPTIONS.						
Local Subscriptions for	1909		6			
do	1910		70			
do	1911		112			
do	1912		488			
do	1913		3740			
do	1914		516			
do	1915		16		4948	
Foreign Subscriptions			5845	33		
Less ¾ share for 1912 paid to A. M. & J. FERGUSON			369		5476	33
,, GOVERNMENT GRANT FOR 1913.					27750	
,, INTEREST						
On Mercantile Bank					200	26
,, SEED SUPPLIES						
Excess Sale over Purchases					218	58

	Purchases.		Sales.	
Vegetable Seeds	234	50	185	
Grafted Plants	1109	01	1438	48
Grass	3	95	34	82
Soya Beans	108	13	94	67
Doob Grass	124	28	—	—
Flower Seeds	5	72	—	—
Paddy	336	85	258	87
Sorgum	2	63	—	—
Coffee	135	13	145	39
T. Purpurea	12	42	17	17
Mangosteen	5	00	—	—
Cotton	21	47	178	30
Maize	13	00	—	—
Onion	9	96	—	—
Bursum	5	50	2	50
Barley	5	10	—	—
Bhere	1	47	—	—
Cholum	8	20	—	—
Sundries	17	49	—	—
Coconuts			20	31
Ground Nuts			2	88
	2159	81		
Excess Sales	218	58	2378	39

Rs.			77168	71

We certify that we have prepared this account of Receipts and Payments from the books

Colombo, June 11th, 1914.

AGRICULTURAL SOCIETY

THE TWELVE MONTHS ENDED 31st DECEMBER, 1913

PAYMENTS.			Rs.	Cts.	Rs.	Cts.
By General Expenditure						
Organising Vice President	3000					
Secretary	1500					
Assistant Editor	499	98				
Proof Reader	120					
Clerks & Peons	4661	75				
Agricultural Instructors	5312	29	15094	02		
Stationery			367	69		
Postages and Telegrams			1859	12		
Office Furniture			824	89		
Bank Charges and Commission			145	87		
Miscellaneous Petty Expenses			1071	95		
Printing General			910	64		
Auditors' Fee for 1912			150		20424	18
,, Travelling Expenses						
Secretary			1475	42		
Agricultural Instructors			9567	16		
Show Judges, &c.			16	50		
Organising Vice President and Staff			52	61	11111	69
,, Tropical Agriculturist & Magazine of C. A. S.						
Printing English Magazine			6754	98		
,, Tamil Edition			203	99		
			6958	97		
Less Received for Advertisement			993	80		
			5965	17		
Add Singhalese Magazine Editor's Fee	450	00				
Printing, Postages, &c.	1284	75				
	1734	75				
Less Subscriptions received	757	87	976	88	6942	05
,, Purchase from A. M. & J. Ferguson Trop. Agri.			30000			
Stamps & Fees			176	50	30176	50
,, Apiculture					99	11
,, Agricultural Show Expenses						
Grants Kalutara District					200	
,, Sericulture Experimental Farm						
Grant to Salvation Army					500	
,, Experimental Gardens						
Bandaragama	200					
Ballala and Hellipola	180					
Jaffna	75					
Kegalle	208	26				
Madipola	25					
Puttalam	115					
Vavuniya	25					
Hambantota	8	75				
Balangoda	230					
Paddy	30					
Nugawella	38	60				
Nakawattee	23					
Anamaduwa	200					
Ambalatota	110	85				
Mediwake	150					
Badulla	151	50	1770	96		
Less Madipola			25		1745	96
,, Agricultural Training					135	89
,, Seed Store at Government Stock Garden						
Coolies' Wages			180	00		
Almirah			37	25		
Miscellaneous			162	19	379	44
,, Agricultural Implement					56	57
,, Cash in Hand						
Mercantile Bank			5211	60		
Stock of Stamps			185	72	5397	32
				Rs.	77168	71

of the Society and that to the best of our belief it is correct.

FORD, RHODES., CHURCH & Co.,
Chartered Accountants.

CAMPHOR OIL.

During the winter the Japanese camphor oil market, considered as a whole, has remained unchanged. Traffic in this important raw material is made very difficult by the practice of the Japanese to dispose of the different grades of the oil only in parcels assorted in definite proportions. If a buyer, for instance, wishes to acquire 1,000 cases of white camphor oil, he is obliged to buy at the same time several thousand cases of brown oil, for which, possibly, he may have no use until the distant future. This business custom of the Japanese greatly impedes operations in camphor oil, and it is to be regretted that, as we are informed, there is no prospect of the abolition of the restriction thus forced upon buyers. The call for our light camphor oil has at times been particularly brisk, especially from England, whence during the month of February an exceptionally strong demand manifested itself. It is true that our stock of heavy camphor oil has not been drawn upon to the same extent, but this oil also has gradually become indispensable for many technical purposes. The prices of both qualities have remained unchanged, and the steady sale is likely to keep the values at their present level during the near future.

The local authorities of the District of Tokyo have last year initiated experiments on a large scale in planting camphor trees on the island-groups situated in the Bay of Tokyo, and especially on the large volcanic Island of Oshima and on the Hachijojima group, north of the Bonin Islands. The trees have stood the summer well, and are said to be making rapid growth. As a result, neighbouring local authorities have followed the example of Tokyo, and afforestation with camphor trees is at present being carried out on the islands near Idzu and on the Bonin Islands. At the beginning of November the first experiment in camphor refining was also made at Oshima, and if the experiments should be successful, the Tokyo local authorities intend to lease the exploitation of camphor on their islands to private companies. In the Island of Formosa, the principal centre of production of Japanese camphor, the last business year has been a very good one. In 1911 the Monopoly Bureau's exports reached a total of 5, 7 million lb., of a value of 3, 6 million *Yen*, but in 1912 the figures were 8, 7 million lb., of a value of 5, 6 million *Yen*. The principal buyers were the United States and Germany, each of which took about 2, 3 million lb.; old Japan took 1, 7 and England 1 million lb., France about 900,000 lb. and India 300,000 lb. For the current year the figures for America and Germany are pretty much the same, England and France have taken considerably increased quantities, and the Indian takings have trebled. But the greatest increase of all is with Old Japan which, it is true, re-exports in turn to other countries, but whose own camphor industry is nevertheless the principal factor accounting for these increased imports. Side by side with the increase in exports there was a reduction in the output in Formosa, with the result that the stocks there are now pretty nearly exhausted. For this reason the management of the Monopoly is now engaged in devising measures for accumulating a sufficiency of fresh supplies as soon as possible. The result of the experiments in the preparation of camphor from leaves has shown that the quantity of camphor contained in the leaves of the tree equals about 25 per cent. of that which is obtainable from the trunk, branches, and twigs. To the question whether enough camphor trees are being planted to compensate for those that are cut down, the Monopoly authorities return a distinct affirmative. It is said that in the districts inhabited by subdued aborigines large areas of camphor trees have also been found to exist, and that there is consequently no cause for anxiety as to the future production of camphor.

We have already on a previous occasion pointed out that the camphor monopoly hopes to find a fresh source of production of camphor in the distillation of camphor leaves. Experiments on a large scale in this direction are being conducted at present at the experimental station on the Tempai mountain (Fukuoka), which is situated in a camphor plantation. This plantation contains about 58,000 trees, which were planted in the year 1908. The daily capacity of the experimental station is 2,000 gallons of oil, or 317 gallons from 400 lb. of leaves (?) Four distillations are carried out daily, the camphor-content of the oil being estimated every three hours. The exhausted material is used as fuel.

At the present time there are over 500,000 camphor trees on the Island of Kiu Shiu (Saikaido), distributed over an area of more than 60,000 acres. As camphor leaves are easily transportable, it would be possible to work up the leaves from a large district in one central station. When distilling camphor wood it is inconvenient to go far afield from the collecting centre, because the wood, being heavy, is not so readily transportable.

Perhaps the projected scheme for a World's Camphor Trust, of which reports appear in the press from time to time, may be connected with the alleged unfavourable position of the Japanese camphor industry. It is said that a preliminary understanding has already been reached between the Kobe houses and the European merchants but that the negotiations with the United States have not yet led to the desired result.—Report of Schimmel & Co.

THREE NEW AND PROFITABLE NUTS.

To the Editor of The Tropical Agriculturist.

Sir.

Planters in the E.Indies and elsewhere have frequently expended large sums of money in producing various crops, which fluctuated greatly in value and ultimately were eradicated through becoming unprofitable. With nuts of any kind this is not likely to occur; as there is always a good demand therefor which increases with population. Great Britain and the United States, to say nothing of other countries, are large consumers and the cultivation of palatable and popular fruits of good keeping quality will prove a lasting and remunerative enterprise. Just now there is a great demand in England and the United States for fruit of this description, amongst which may be enumerated three new nuts, viz. the Peli Nut, or Java Almonds (*Canarium ovatum*), the Paradise Nut (*Lecythis labucajo*), and the Queensland Nut (*Macadamia ternifolia*). It is said that commercially the Peli Nut is the most important which has appeared on the American market during recent years. The nuts have a very thick shell, but the kernel is so delicate and nutritious that an emulsion of it is frequently used as a substitute for milk in bringing up infants. A valuable commercial oil is pressed from them, while the resin of the tree is the "gum elemi" of pharmacists, used in plasters and ointments. Even the pulpy husk of thoroughly ripe nuts is eaten by Filipinos in some districts.

The tree attains a height of 50 feet and the nuts furnish an important article of food to the natives, but they are considered very unwholesome if eaten fresh, and cause dysentery and diarrhœa. They are eaten both raw and roasted, and in Amboyna they are converted into bread which is made in rolls about a yard in length and one inch thick; they are also made into a sort of marmalade. An oil is expressed from them which is used at the table when fresh, and in lamps when stale.

The Paradise Nut is somewhat similar to the Peli and is a near relative of the common Brazil Nut. The native name is Sapucaia and under this name it is sold in Europe. The designation "Paradise Nut" appears to have originated in New York. The seeds are enclosed in hard, woody "pots" or "urns," provided with lids which fall when the fruit is ripe, allowing the nut to drop to the ground. These nuts in the United States bring 75 cents or 3*s* 1½*d* per lb. The preference for them is due to the fact that the meat is considered of a finer flavour as well as more digestible. The shell, moreover, is thin, in pleasing contrast to either the Peli or the Queensland Nut which both have very thick, hard coverings. The trees attain a large size and furnish excellent timber which is considered particularly resistant to the attacks of teredos and barnacles in salt water.

The Queensland Nut (*Macadamia ternifolia*) is more interesting than either of the two preceding, as it bears earlier and can be cultivated in a wider extent of country. It is resistant to drought and fairly resistant to frost, and promises to be of much value commercially. Small shipments to London are said to have been sold at 10/-per lb. There are about 50 nuts to the lb. The fruit is a drupe with fleshy exterior; the brown kernel (the nut itself) has a shiny surface. The meat enclosed therein has a delicious flavour, closely resembling that of the Brazil Nut. It requires very little care or water, wherefore it should be highly prized in semi-arid localities. The cultivation of this nut tree should prove one of the most reliable and lucrative enterprises for planters in the E.Indies.

Yours faithfully,

B. HARRISON, F.L.S.

Burringbar P.O.
N. S. W., Australia, 7-5-14.

[*Macadamia ternifolia* was introduced into Ceylon in 1868, and bears fruit at Peradeniya. It might form a welcome addition to a bungalow garden, but opinions differ as to its edible qualities. There is no fortune to be made out of the cultivation of dessert nuts.]

OIL PALM FRUITS IN GABON.

BY PAUL AMMANN.

The oil palm, distributed over a large part of tropical Africa, but particularly abundant round the Gulf of Guinea, furnishes palm oil and palm kernels, which enter in enormous quantities into the manufacture of candles, soap and vegetable butters. In the year 1909 the total export from West Africa (from Gambia to Angola) was 100,000 tons of palm oil, and 250,000 tons of palm kernels, representing a value of about 200 million francs.

This enormous production, however, does not meet the consumption, which increases more rapidly than the production. Consequently, on the market, the price of oil stuffs increases daily, and there is at present an endeavour to develop this production of oil stuffs; in the case of the oil palm, either by improving the native processes of extraction, and replacing them with machinery, or by bringing into exploitation palms as yet unexploited, or finally by creating in certain countries new palm plantations.

The oil palm is one of the chief resources of Gabon, but trade and natives have not yet drawn on it to its fullest extent, and large numbers of palms are not yet exploited even in the coastal regions which are easy of access.

The climate and soil in Gabon, being extremely favourable to the oil palm, permit of an abundant fructification, estimated at an average of 8 to 10 fruit branches of 12 kilos each, representing 100 kilos of fruit branches per tree per annum : these fruit branches bear fruits, which are more bulky than anywhere else in Africa.

The data collected below were obtained by analysis made on samples collected on the banks of the Ogooné, and sent to the Jardin Colonial by M. F. COTON.

The following is a summary of the statistics given—

Weight of an average fruit branch - - 13 kilos
Yielding fresh fruits (about 20 % water) - 7·8 ,,
or dry fruits (about 4 % water) - - 6·5 ,,

Two samples were taken of fruits :

No. 1 Average weight of fruit 8 grams
No. 2 ,, ,, ,, 112 ,,

No. 1 gave Pulp 38·2 per cent.
Nuts 61·8 ,, {Shell 43·5 %
{Kernel 18·3 %
Average weight of nut 4·9 grams
,, ,, kernel 2·4 ,,

No. 2 gave Pulp 20·0 per cent.
Nuts 80·0 ,, {Shell 63·76 %
{Kernel 16·24 %
Average weight of nut 8·8 grams
,, ,, kernel 1·6 ,,

	Composition of Pulp.		Composition of Kernels.	
	No. 1.	No. 2.	No. 1.	No. 2.
	per cent.	per cent.	per cent.	per cent.
Water ...	3·29	4·5	8·5	10·8
Oil stuff ...	77·14	65·48	45·9	47·8

—L'AGRONOMIE COLONIALE.

INTERNATIONAL CONVENTION ON PLANT DISEASES.

The text of the draft convention which was prepared at this conference has now been issued by the International Agricultural Institute at Rome, and the Governments which were represented on that occasion will be invited to consider whether they will signify their formal acceptance of the proposed agreement. Their decision will depend on political and administrative reasons with which we are not here concerned, but the suggestions contained in the document mark an advance in public opinion on the subject of plant diseases of great interest to men of science, which cannot be entirely overlooked. The delegates of thirty independent States have decided that it is desirable that a uniform procedure should be adopted to control the spread of those

diseases which have in the past done so much injury to agricultural and horticultural crops, and, indeed, are still doing so, and that this procedure should include both the scientific study of the insect and fungus pests at one or more Government phytopathological stations in each country, and the application of remedial measures by administrative order where these pests exist.

The official acceptance of this policy would in any case give a great stimulus to the study of applied biology, and would tend to concentrate the attention of entomologists and mycologists on economic problems. But the scheme contemplated by some of the articles of the convention is likely to be productive of even more important results. It was evidently felt impossible to prepare a list of dangerous diseases applicable to all countries, and while, on the one hand, it was decided not to legislate for those diseases which attack agricultural crops, such as seeds, grain, potatoes, and other "articles de grande culture," each Government is invited to prepare a list of those diseases against which it wishes to be protected. The preparation of such a list is bound to be difficult, since many of the diseases which are comparatively harmless in a country where they have been established for many years are apt to assume a virulent character when introduced into a country where they are unknown. The ravages caused by the Brown Tail Moth (*Euproctis chrysorrhoea*) and the Cotton Boll Weevil (*Anthonomus grandis*) in America, by the Vine Louse (*Phylloxera vastatrix*) and the American Gooseberry mildew (*Sphaerotheca mors-Uvae*) in Europe, are familiar examples. The attention of official plant pathologists will have, therefore, to be directed not only to the study of the pests of their own country, but also to those of other countries the character of which is such that they might prove dangerous if introduced. [It is difficult to imagine an official plant pathologist who neglects this duty. —ED. T. A.]

The field for this kind of research is, of course, very wide; but lest an opening should be given to unreasonable and alarmist measures likely to cause a serious disturbance of trade, it is laid down in a very important article what are the conditions on which the list must be prepared. It is wisely declared that the list must be as restricted as possible, and must not include any of those common pests which are widely distributed in almost every country, and are well established there. (Les espèces banales, dont la dispersion déjá ancienne s'étend á presque tous les pays). Moreover, the pest must be epidemic in character, and destructive, or at least very injurious, in action, as well as be easily capable of being conveyed on living plants, or parts of plants.

In these cases where the pest is already known to be of such a character in its native home or in some country into which it has already been introduced, its inclusion in the list is a foregone conclusion, and there will be little hesitation about the San José Scale (*Aspidiotus perniciosus*) or the Mediterranean Fruit Fly (*Ceratitis capitata*), the Black Knot (*Plowrightia morbosa*) or the Chestnut disease (*Endothia parasitica*). But in other cases a difficulty will arise. Where experience cannot speak with certainty, a scientific reason must be urged, and it will be necessary to formulate a series of deductions from the life-history of the insect or fungus which would justify a presumption that in different surroundings the pest might prove epidemic as well as destructive to plant life, or at least injurious to the crop. No doubt it will be possible, in the course of time, to declare with more accuracy than at present what are the circumstances in which such conditions might arise; but it will require a long and careful study; not only of plant hygiene, but also of the limits of the powers of adaptation to environment possessed by parasitic organisms, under the stimulus of climatic and cultural conditions, as well as freedom from injurious influence. This article in the proposed convention will, if adopted, have a marked influence on the trend of economic biology and plant pathology.—NATURE.

SUCCESSFUL METHOD OF TRANSPORTING CANE CUTTINGS.

Although the method of shipping cane cuttings in damp charcoal has been known for many years, there has always been considerable risk involved on account of the time occupied by the transportation to distant countries. With a view to overcoming this difficulty, this Department last year decided to try the experiment of shipping cane cuttings in damp charcoal (1 lb. charcoal, 4 oz. water) to India by parcel post, thereby lessening the time of transportation. On account of the maximum weight which is allowed in sending by parcel post, being 11 lb., it was found necessary to have special tins constructed, and to reduce to a minimum the size of the cane cuttings. The light tins employed measured 18 inches × 4 inches × 4 inches, and cuttings were selected having the nodes moderately close together, thereby getting a good number of buds per cutting with a minimum bulk of cane.

The time taken during the transportation was only six weeks. On its arrival in India, the case of cuttings was opened immediately, and the following observations on the condition of the cuttings were recorded: Many of the buds had already sprouted, the sprouts varying from ½ inch to 2 to 3 inches in length. In a few cases rootlets had developed 1 to 2 inches long. These looked in perfect condition and were unbroken and undamaged. The canes themselves were perfectly healthy in appearance, not in the least dried or shrivelled up, quite hard and bright in colour.

The cuttings were planted out at once and in a later communication from the Agricultural Chemist, Assam, it was stated that the cuttings had all germinated and were doing well.

As an interesting extension of the experiment, this Department requested the Indian authorities to reciprocate the trial by forwarding cuttings of any good Indian cane by the same method to the West Indies. The cuttings of a variety known as "Dacca Gandari" have recently been received at this office in good condition and forwarded to Antigua where their germination capacities will be tested. It is interesting to add that this Indian cane is described as a very free tillerer, good cropper, and of high quality.—AGRICULTURAL NEWS.

RAINFALL FOR JUNE, 1914

Place	1914	1913	Place	1914	1913
	in.	in.		in.	in.
Colombo	10·29	5·27	Kurunegala	5·88	4·82
Kandy	9·30	6·26	Batticaloa	1·15	·08
Galle	11·15	4·22	Badulla	·66	·49
Jaffna	·56	·06	Ratnapura	16·51	6·05
Anuradhapura	·26	·45	Nuwara Eliya	10·90	7·07

MARKET RATES FOR TROPICAL PRODUCTS.

(From Lewis & Peat's Latest Monthly Prices Current.

	QUALITY.	Quotations.
ALOES, Socotrine cwt.	Fair to fine	40/ a 50/
Zanzibar & Hepatic ,,	Common to good	40/ a 70/
ARROWROOT (Natal) lb.	Fair to fine	5d
BEES' WAX cwt.		
Zanzibar Yellow ,,	Slightly drossy to fair	£7 10/ a £7 15/
East Indian, bleached ,,	Fair to good	£8 10/a £8 12/6
,, unbleached ,,	Dark to good genuine	£6 5/ a £7
,, Madagascar ,,	Dark to good palish	£7 15/ a £8 2/6
CAMPHOR, Japan lb.	Refined	1/7 a 1/8
China cwt.	Fair average quality	155/
CARDAMOMS, Tuticorin	Good to fine bold	5/1 a 5/4
per lb.	Middling lean	3/9 a 4/7
Malabar, Tellicherry ,,	Good to fine bold	5/9 a 6/3
Calicut ,,	Brownish	3/3 a 4/9
Mangalore ,,	Med Brown to good bold	3/10 a 6/3
Ceylon, Mysore ,,	Small fair to fine plump	4/ a 6/3
Malabar ,,	Fair to good	3/ a 3/3
Seeds, E. I & Ceylon ,,	Fair to good	4/ a 4/3
Ceylon "Long Wild" ,,	Shelly to good	2/3 a 3/6 nom.
CASTOR OIL, Calcutta ,,	Good 2nds	3$\frac{3}{8}$d
CHILLIES, Zanzibar cwt.	Dull to fine bright	45/ a 50/
Japan ,,	Fair bright small	50/
CINCHONA BARK.—lb.	Crown, Renewed	3$\frac{3}{8}$ d a 7 d
Ceylon	Org. Stem	2d a 6d
	Red Org. Stem	1$\frac{1}{4}$ d a 4$\frac{1}{4}$d
	Renewed	3d a 5$\frac{1}{4}$d
	Root	1$\frac{1}{2}$d a 4d
CINNAMON, Ceylon 1sts.	Good to fine quill	1/3 a 1/9
per lb. 2nds.	,, ,,	1/2 a 1/7
3rds	,, ,,	1/1 a 1/6
4ths.	,, ,,	1/ a 1/3
Chips.	Fair to fine bold	2d a 4d
CLOVES, Penang lb.	Dull to fine bright pkd.	1/ a 1/2
Amboyna ,,	Dull to fine	10d a 10$\frac{1}{2}$d
Zanzibar ,,	Fair and fine bright	5$\frac{3}{8}$d a 6d
Madagascar ,,	Fair	7d
Stems ,,	Fair	2d
COFFEE		
Ceylon Plantation cwt.	Medium to bold	Nominal
Liberian ,,	Fair to bold	63/ a 80/
COCOA, Ceylon Plant. ,,	Special Marks	81/ a 88/6
	Red to good	73/ a 80/6
Native Estate ,,	Ordinary to red	42/ a 68/
Java and Celebes ,,	Small to good red	30s a 93s
COLOMBO ROOT ,,	Middling to good	15/ a 22/6
CROTON SEEDS, sifted,,	Dull to fair	42/6 a 47/6
CUBEBS ,, ,,	Ord. stalky to good	130/ a 150/
GINGER, Bengal, rough ,,	Fair	19/
Calicut, Cut A ,,	Medium to fine bold	60/ a 75/
B & C ,,	Small and medium	36/ a 60/
Cochin, Rough ,,	Common to fine bold	22/6 a 27/
	Small and D's	20/
Japan ,,	Unsplit	20/
GUM AMMONIACUM ,,	Ord. Blocky to fair clean	40/s a 72s 6d
ANIMI, Zanzibar	Pale and amber, str. srts	£14 10/a £16 10/
,,	,, ,, little red	£11 a £12
,,	Bean and Pea size ditto	70/ a £11
,,	Fair to good red sorts	£8 10/ a £10 10/
,,	Med. and bold glassy sorts	£5 10/ a £7 5/
Madagascar ,,	Fair to good palish	£4 a £8
,,	,, ,, red	£4 a £7
ARABIC, E. I. & Aden ,,	Ordinary to good pale	26/ a 32/6
Turkey sorts ,,	,, ,,	35/ a 57/6
Ghatti ,,	Sorts to fine pale	17/ a 27/
Kurrachee ,,	Reddish to good pale	22/6 a 32/6 nom.
Madras ,,	Dark to fine pale	20/ a 30/ nom
ASSAFŒTIDA ,,	Clean fr. to gd. almonds	£6 a £6 10/
	com. stony to good block	40s a £5
KINO lb.	Fair to fine bright	6d a 1/5
MYRRH, Aden sorts cwt.	Middling to good	57/6 a 67/6
Somali ,,	,, ,,	52s 6d a 55s
OLIBANUM, drop ,,	Good to fine white	45s a 50s
,,	Middling to fair	35s a 40s
pickings ,,	Low to good pale	15/ a 27/6
siftings ,,	Slightly foul to fine	18s a 25s
INDIA RUBBER lb.	Fine Para smoked sheets	2/3$\frac{3}{4}$
	Crepe ordinary to fine	2/4
Ceylon, Straits, ,,	Fine Block	2/4$\frac{1}{4}$
Malay Straits, etc. ,,	Scrap fair to fine	1/8 a 1/9
Assam ,,	Plantation	1/10
,,	Fair 11 to ord. red No. 1.	1/3 a 1/6
Rangoon ,,	,, ,, ,,	1/2 a 1/4

	QUALITY.	QUOTATIONS.
INDIA RUBBER lb.		
Borneo ,,	Common to good	9d a 1/3
Java ,,	Good to fine red	1/3 a 1/6
Penang ,,	Low white to prime red	9 d a 1/4
Mozambique ,,	Fair to fine red ball	1/9 a 2/1
,,	Sausage, fair to good	1/9 a 2/
Nyassaland ,,	Fair to fine ball	1/9 a 2/
Madagascar ,,	Fr. to fine pinky & white	1/4 a 1/6
,,	Majunga & blk coated	1/ a 1/2
,,	Niggers, low to good	6d a 1/6
New Guinea ,,	Ordinary to fine ball	1/4 a 1/7
INDIGO, E.I. Bengal ,,	Shipping mid to gd. violet	3s 3d a 3s 8d
,,	Consuming mid. to gd.	2s 9d a 3s 2d
,,	Ordinary to middling	2s 4d a 2s 9d
,,	Mid. to good Kurpah	1s 11d a 2s 5d
,,	Low to ordinary	1s 6d a 1s 9d
,,	Mid. to fine Madras	1/11 a 2/9
MACE, Bombay & Penang	Pale reddish to fine	2/4 a 2/6
per lb.	Ordinary to fair	2/ a 2/2
Java	,, ,, good pale	2/ 1 a 2/4
Bombay	Wild	1/
NUTMEGS,— lb.		
Singapore & Penang ,,	64's to 57's	9$\frac{1}{2}$d a 10$\frac{1}{2}$d
	80's	7$\frac{1}{2}$d
	110's	6$\frac{1}{2}$d
NUTS, ARECA cwt.	Ordinary to fair fresh	17/6 a 20/
NUX VOMICA, Cochin	Ordinary to good	13/6 a 15/
per cwt. Bengal	,, ,,	12/
Madras	,, ,,	12/ a 13/
OIL OF ANISEED lb.	Fair merchantable	5/3
CASSIA ,,	According to analysis	2/9 a 3/
LEMONGRASS oz.	Good flavour & colour	2$\frac{3}{4}$d
NUTMEG ,,	Dingy to white	1$\frac{1}{2}$d a 1$\frac{3}{4}$d
CINNAMON ,,	Ordinary to fair sweet	3$\frac{1}{2}$d a 1s 5d
CITRONELLE lb.	Bright & good flavour	1/5$\frac{3}{4}$
ORCHELLA WEED—cwt		
Ceylon ,,	Fair	10/6
Madagascar ,,	Fair	10/6
Zanzibar ,,	Fair	10/6
PEPPER—(Black) lb.		
Alleppy & Tellicherry ,,	Fair	5d
Ceylon ,, ,,	Fair to fine bold heavy	5d a 5$\frac{3}{8}$d
Singapore ...	Fair	4$\frac{5}{8}$d
Acheen & W. C. Penang	Dull to fine	5d a 5$\frac{1}{2}$d
(White) Singapore ,,	Fair to fine	8$\frac{1}{2}$d a 8$\frac{3}{4}$d
Siam ,,	Fair	8$\frac{1}{2}$d
Penang ,,	Fair	7$\frac{3}{8}$d
Muntok ,,	Fair	9d
RHUBARB, Shenzi ,,	Ordinary to good	2/ a 4/
Canton ,,	Ordinary to good	1/10 a 3/6
High Dried,,	Fair to fine flat	11d a 1/1
	Dark to fair round	9 d a 11d
SAGO, PEARL, large--cwt	Fair to fine	18/
medium ...	,, ,,	16/
small ...	,, ,,	13/ a 14/
Flour ...	Good pinky to white	10/ a 11/
SEEDLAC cwt.	Ordinary to gd. soluble	65/ a 75/
SENNA, Tinnevelly lb.	Good to fine bold green	5d a 8$\frac{1}{2}$d
	Fair greenish	3d a 4$\frac{1}{2}$d
	Common specky & small	1$\frac{1}{2}$d a 2$\frac{1}{2}$d
SHELLS, M. o' PEARL—		
Egyptian cwt.	Small to bold	85/ a £5 15/
Bombay ,,	,, ,,	77/6 a £5 5/
Mergui ,,	Chicken to bold	£9 10/ a £14 10/
Manilla ,,	Fair to good	£8 a £13 12/6
Banda ,,	Sorts	50/ nom.
Green Snail ,,	Small to large	67/6 a 80/
Japan Ear ,,	Trimmed selected small to bold	25/ a £6 17/6
TAMARINDS, Calcutta...	Mid to fine bl'k not stony	14/ a 15/
per cwt. Madras	Inferior to good	6/ a 10/
TORTOISESHELL—		
Zanzibar & Bombay lb.	Small to bold	14/ a 24/
	Pickings	8/6 a 16/6
TURMERIC, Bengal cwt.	Fair	12/ a 13/
Madras ,,	Finger fair to fine bold	14/ a 16/
Do. ,,	Bulbs ,, ,, [bright	12/ a 13/
Cochin ,,	Finger fair	13/ nom
	Bulbs ,,	11/6 a 12/
VANILLOES— lb.		
Mauritius ... 1sts.	Gd. crystallized 3$\frac{1}{2}$a 8$\frac{1}{2}$ in.	9/6 a 15/
Madagascar ... 2nds.	Foxy & reddish 3$\frac{1}{2}$a ,,	9/ a 12/
Seychelles ... 3rds.	Lean and inferior	9/ a 9/6
VERMILLION ... lbs.	Fine, pure, bright	2/7
WAX, Japan, squares cwt.	Good white hard	48/

BAD TAPPING